User Manual

Allen-Bradley

Kinetix 5500 Servo Drives

Catalog Numbers 2198-H003-ERS, 2198-H008-ERS, 2198-H015-ERS, 2198-H025-ERS, 2198-H040-ERS, 2198-H070-ERS
2198-CAPMOD-1300

Original Instructions

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

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About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting the Kinetix® 5500 servo drives; and system integration for your drive/motor combination with a Logix5000™ controller.

Who Should Use This Manual

This manual is intended for engineers or technicians directly involved in the installation and wiring of the Kinetix 5500 drives; and programmers directly involved in the operation, field maintenance, and integration of these drives with the EtherNet/IP communication module or controller.

If you do not have a basic understanding of the Kinetix 5500 drives, contact your local Rockwell Automation sales representative for information on available training courses.

Conventions Used in This Manual

These conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.

Studio 5000 Environment

The Studio 5000™ Engineering and Design Environment combines engineering and design elements into a common environment. The first element in the Studio 5000 environment is the Logix Designer application. The Logix Designer application is the rebranding of RSLogix™ 5000 software and will continue to be the product to program Logix5000 controllers for discrete, process, batch, motion, safety, and drive-based solutions.

The Studio 5000 environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. It is the one place for design engineers to develop all the elements of their control system.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Kinetix 5500 servo drives Installation Instructions, publication 2198-IN001	Information on mounting and wiring the Kinetix 5500 servo drive.
Kinetix 5500 Feedback Connector Kit Installation Instructions, publication 2198-IN002	Information on installing and wiring the Kinetix 5500 motor feedback connector kit.
Kinetix 5500 AC Line Filter Installation Instructions, publication 2198-IN003	Information on installing and wiring the Kinetix 5500 AC line filters.
Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004	Information on installing and wiring the Kinetix 5500 capacitor module.
Kinetix 5500 Shared-bus Connection System Installation Instructions, publication 2198-IN005	Information on installing the AC input connectors, T connectors, and bus bars for the Kinetix 5500 AC/DC shared-bus connection system.
Kinetix 300 Shunt Resistor Installation Instructions, publication 2097-IN002	Information on installing and wiring Kinetix 300 shunt resistors.
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Information, examples, and techniques designed to minimize system failures caused by electrical noise.
EMC Noise Management DVD, publication GMC-SP004	
Kinetix Motion Control Selection Guide, publication GMC-SG001	Overview of Kinetix servo drives, motors, actuators, and motion accessories designed to help make initial decisions for the motion control products best suited for your system requirements.
Kinetix 5500 Drive Systems Design Guide, publication GMC-RM009	System design guide to select the required (drive specific) drive module, power accessory, feedback connector kit, and motor cable catalog numbers for your Kinetix 5500 drive and Kinetix VP motor motion control system.
Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001	Product specifications for Kinetix VP (Bulletin VPL), MP-Series (Bulletin MPL, MPM, MPF, MPS), Kinetix 6000M (Bulletin MDF), TL-Series™, RDD-Series™, and HPK-Series™ rotary motors.
Kinetix Servo Drives Specifications Technical Data, publication GMC-TD003	Product specifications for Kinetix Integrated Motion over the EtherNet/IP network, Integrated Motion over sercos interface, EtherNet/IP networking, and component servo drive families.
Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004	Product specifications for Bulletin 2090 motor and interface cables, low-profile connector kits, drive power components, and other servo drive accessory items.
Rockwell Automation Configuration and Selection Tools website http://www.rockwellautomation.com/en/e-tools	Motion Analyzer application analysis software for drive/motor sizing.
	Online product selection and system configuration tools, including AutoCAD (DXF) drawings.
Rockwell Automation Product Certification, website http://www.rockwellautomation.com/products/certification	For declarations of conformity (DoC) currently available from Rockwell Automation.
Integrated Motion on the EtherNet/IP Network Configuration and Startup User Manual, publication MOTION-UM003	Information on configuring and troubleshooting your ControlLogix® and CompactLogix™ EtherNet/IP network modules.
ControlFLASH Firmware Upgrade Kit User Manual, publication 1756-QS105	For ControlFLASH™ information not specific to any drive family.
National Electrical Code, published by the National Fire Protection Association of Boston, MA	An article on wire sizes and types for grounding electrical equipment.
Rockwell Automation Industrial Automation Glossary, publication AG-7.1	A glossary of industrial automation terms and abbreviations.

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Start

Use this chapter to become familiar with the design and installation requirements for Kinetix 5500 drive systems.

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About the Kinetix 5500 Servo Drive System

The Kinetix 5500 servo drives are designed to provide a Kinetix Integrated Motion solution for your drive/motor application.

Table 1 - Kinetix 5500 Drive System Overview

Drive System Component	Cat. No.	Description
Kinetix 5500 Servo Drives	2198-H*xxx*-ERS	200V-class (single-phase or three-phase) and 400V-class (three-phase) drives operate in standalone and multi-axis shared AC, shared DC, shared AC/DC, and shared AC/DC hybrid configurations. Modules are zero-stacked from drive-to-drive and use the shared-bus connection system to extend power in multi-axis configurations.
Kinetix 5500 Capacitor Module	2198-CAPMOD-1300	Used for energy storage and/or to improve performance in applications producing regenerative energy and requiring shorter duty cycles (1360 µf). Modules are zero-stacked side-by-side with servo drives and use the shared-bus connection system to extend power.
Shared-bus Connector Kits	2198-H040-*x*-*x*	Input wiring connectors and DC bus T connector for frame 1 and 2 servo drives.
	2198-H070-*x*-*x*	Input wiring connectors and DC bus T connector for frame 3 servo drives.
Feedback Connector Kit	2198-KITCON-DSL	Replacement feedback connector kit with 2-pin connector plug and grounding plate inside the connector housing.
I/O Connector Kits	2198-KITCON-IOSP	Replacement I/O connector kit (spring clamp) for I/O (IOD) connector.
	2198-KITCON-IOSC	Replacement I/O connector kit (screw terminal) for I/O (IOD) connector.
Connector Sets	2198-KITCON-PWR40	Replacement connector set, 40 A, for frame 1 and frame 2 drives.
	2198-KITCON-PWR70	Replacement connector set, 70 A, for frame 3 drives.
Logix5000 Controller Platform	1769-L18ERM 1769-L27ERM 1769-L30ERM 1769-L33ERM 1769-L36ERM	CompactLogix 5370 controllers with Integrated Motion on the EtherNet/IP network. Linear, ring, and star topology is supported.
	1756-EN2T module 1756-EN2TR module 1756-EN3TR module	ControlLogix 1756-L7*x* controllers with Integrated Motion on EtherNet/IP networks. Linear, device-level ring (DLR), and star topology is supported.
Studio 5000™	N/A	Studio 5000 Logix Designer application (version 21.00 or later) provides support for programming, commissioning, and maintaining the CompactLogix and ControlLogix controller families.
Compatible Motors	VPL-A*xxxx* VPL-B*xxxx*	Compatible rotary motors include 200V and 400V-class Kinetix VP (Bulletin VPL) servo motors.
	N/A	Induction motors with open loop volts/hertz frequency control are also supported.
Cables	2090-CS*x*M1DF-*xx*AA*xx*	Bulletin 2090 single-cable for motor power, feedback, and 24V DC brake power.
	1585J-M8CBJM-*x*	Ethernet cables are available in standard lengths. Shielded cable is recommended.
AC Line Filters	2198-DB08-F 2198-DB20-F 2198-DB42-F	Bulletin 2198 three-phase AC line filters are required to meet CE and available for use in all Kinetix 5500 drive systems.
24V DC Power Supply	1606-XL*xxx*	Bulletin 1606 24V DC power supply for control circuitry, digital inputs, safety, and motor brake.
External Shunt Resistors	2097-R6 and 2097-R7	Bulletin 2097 external passive shunt resistors for when the drive's internal shunt capability is exceeded.

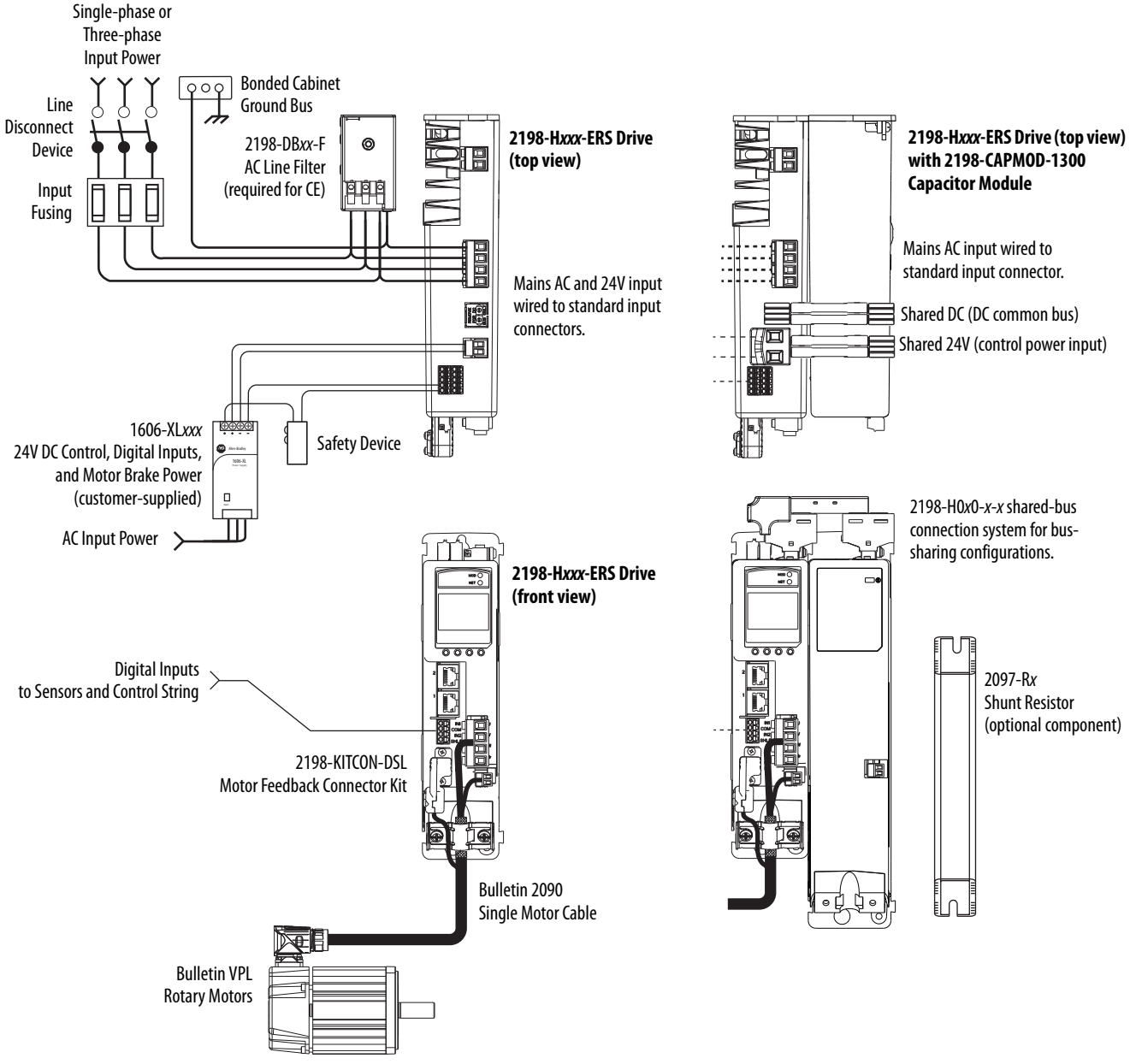
Typical Hardware Configurations

Typical Kinetix 5500 systems include single-phase and three-phase standalone configurations, three-phase shared AC, shared AC/DC, shared DC, and shared AC/DC hybrid configurations.

Standalone Configurations

In these examples, a single standalone drive is shown with and without the Bulletin 2198 capacitor module.

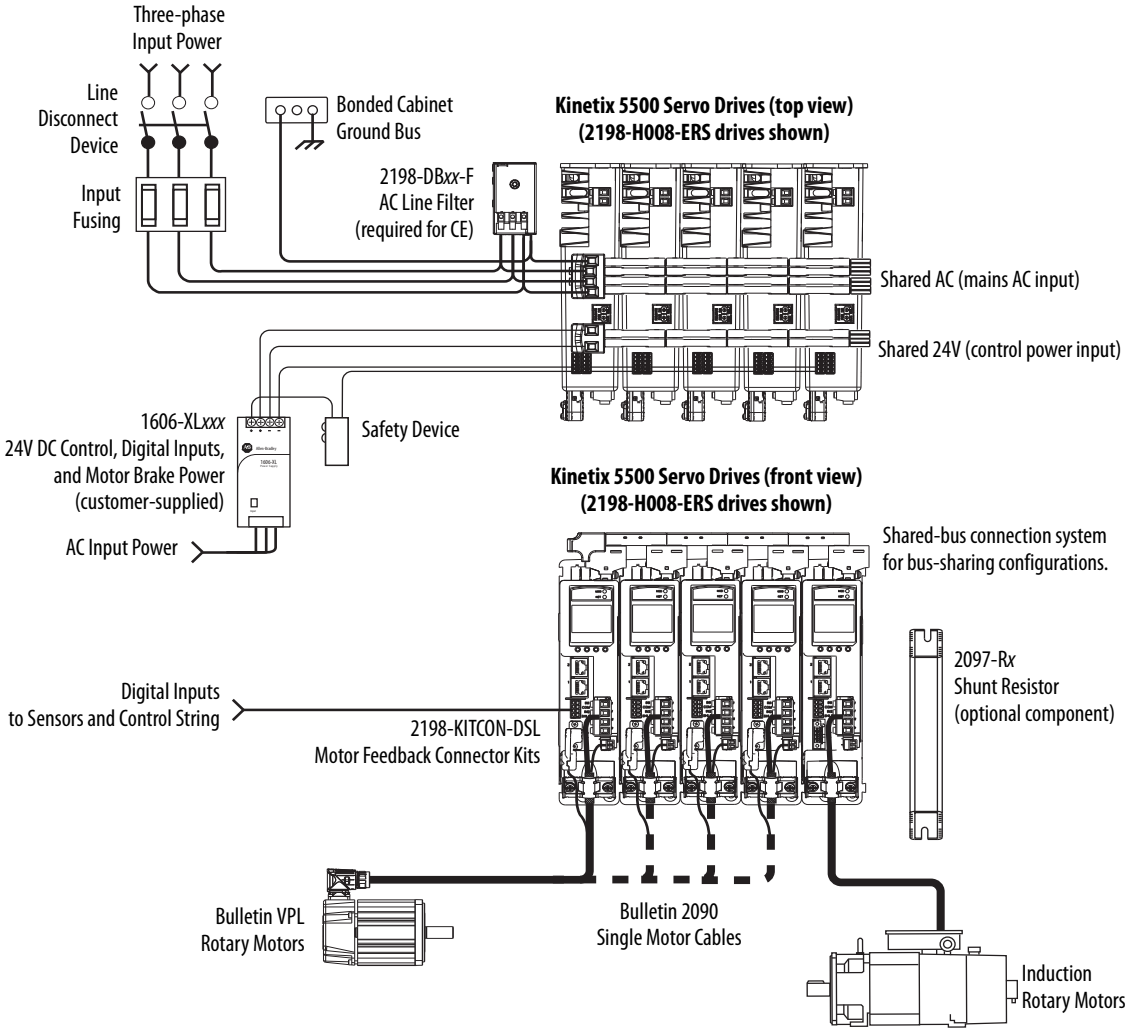
Figure 1 - Typical Kinetix 5500 Standalone Installation



Shared AC Configurations

In this example, three-phase AC power and 24V control power is shared in a multi-axis configuration. All drives must have the same power rating (catalog number).

Figure 2 - Typical Shared AC Installations



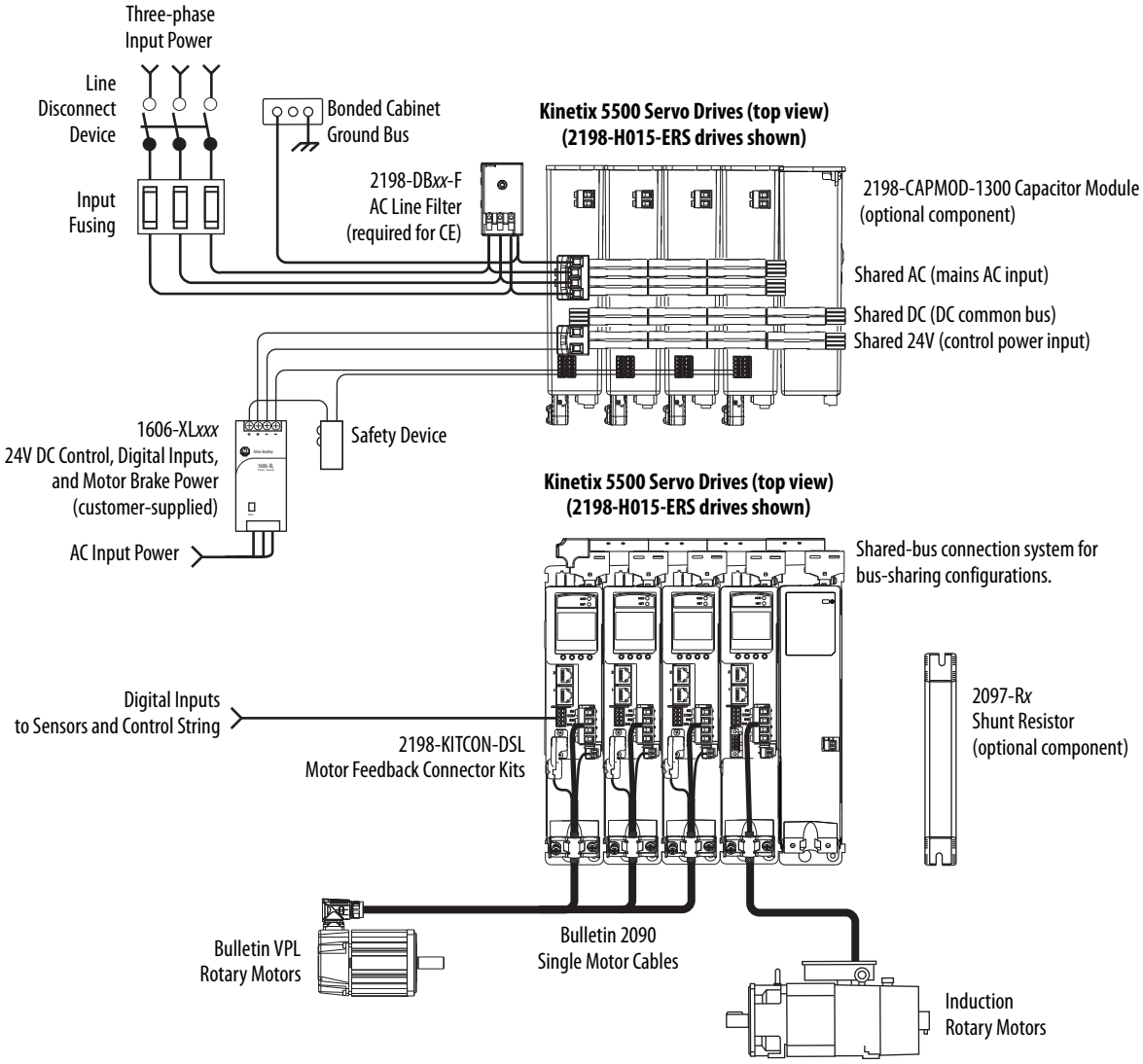
IMPORTANT In shared AC configurations, all drives must have the same power rating.

Shared AC configurations do not support Bulletin 2198 capacitor modules.

Shared AC/DC Configurations

In this example, three-phase AC input power, 24V control power, and DC bus power are shared in a multi-axis configuration. All drives must be the same power rating (catalog number).

Figure 3 - Typical Shared AC/DC Installations

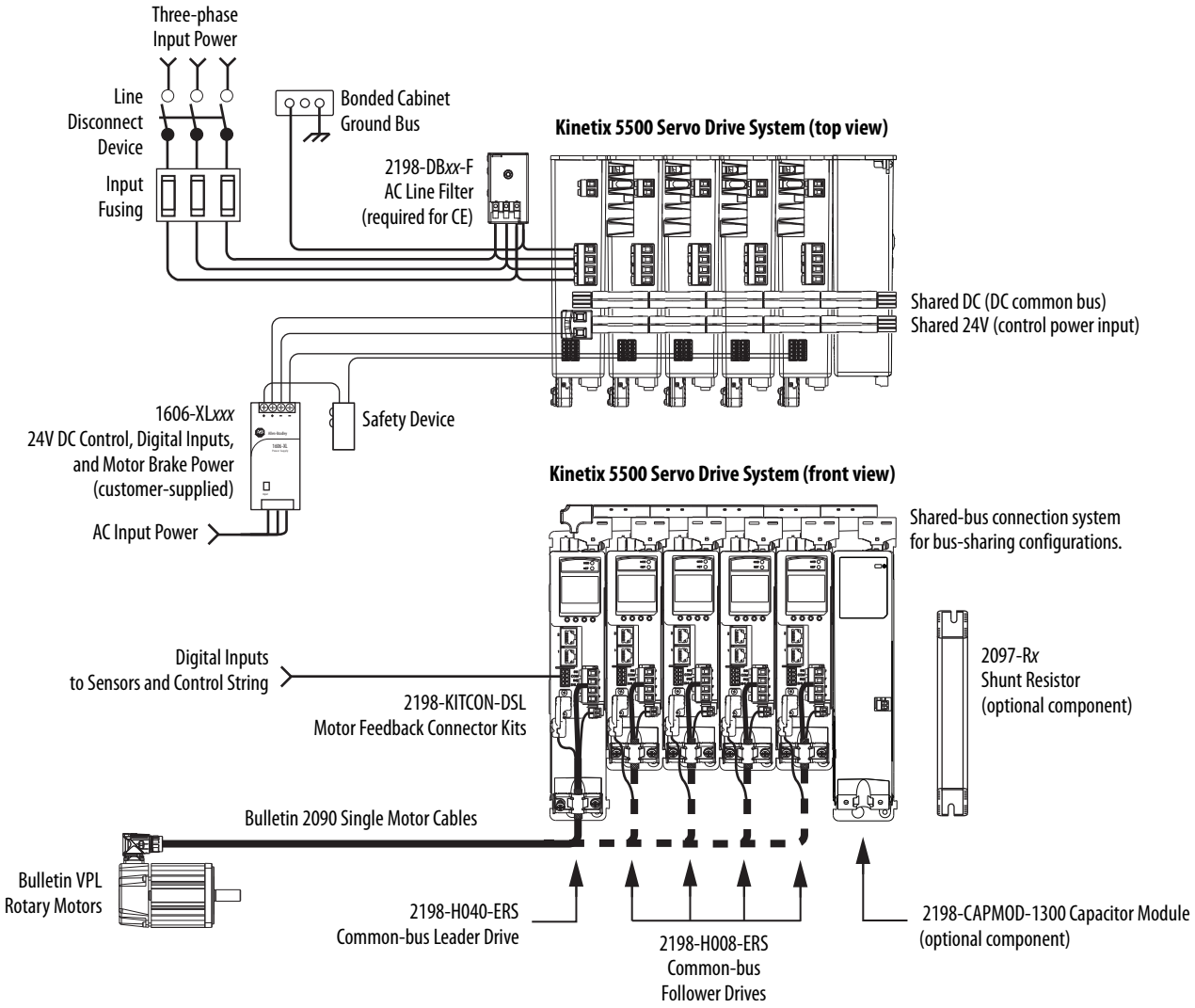


IMPORTANT In shared AC/DC configurations, all drives must have the same power rating (catalog number).

Shared DC Common-bus Configurations

In this multi-axis example, the common-bus leader (sourcing) drive receives three-phase AC input power and supplies DC power to common-bus follower (sinking) drives. The common-bus leader drive power rating is greater than or equal to the power rating of each follower drive.

Figure 4 - Typical Shared DC Common-bus Installations

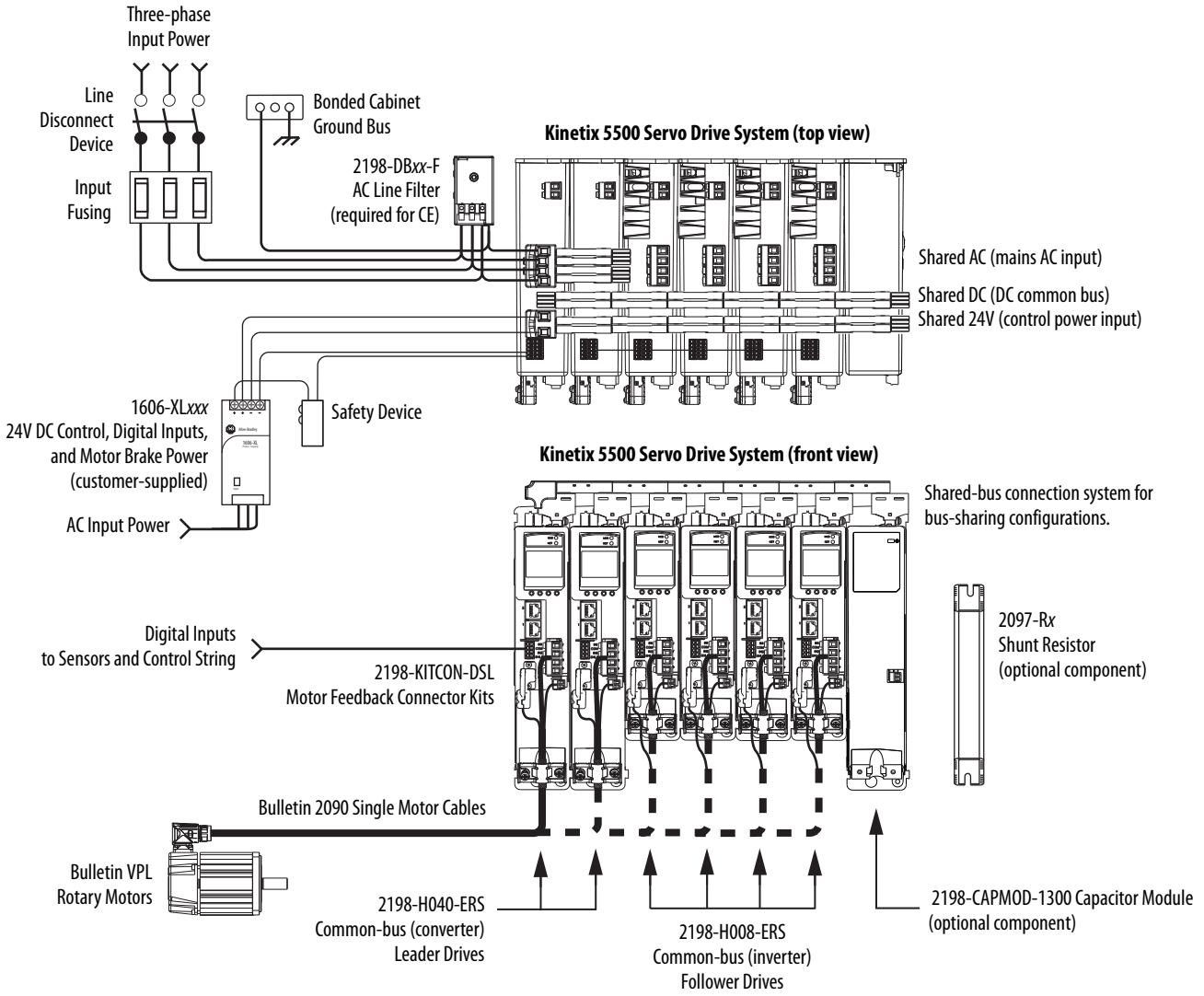


IMPORTANT In shared DC common-bus configurations, the leader drive power rating must be greater than or equal to the power rating of the follower drives.

Shared AC/DC Hybrid Configuration

In this multi-axis example, three-phase AC input power is supplied to two converter drives. The converter drive ratings must be the same, and greater than or equal to the power ratings of the inverter drives. This parallel converter configuration increases the DC power supplied to the inverter drives.

Figure 5 - Typical Shared AC/DC Bus Hybrid Installations



IMPORTANT In shared AC/DC hybrid configuration, the converter drives must have the same power rating and must be greater than or equal to the power ratings of the inverter drives.

Typical Communication Configurations

The Kinetix 5500 drives support any Ethernet topology including linear, ring, and star.

These examples feature the CompactLogix 5370 programmable automation controllers (catalog number 1769-L36ERM) with support for Integrated Motion over the EtherNet/IP network. Controller features include the following:

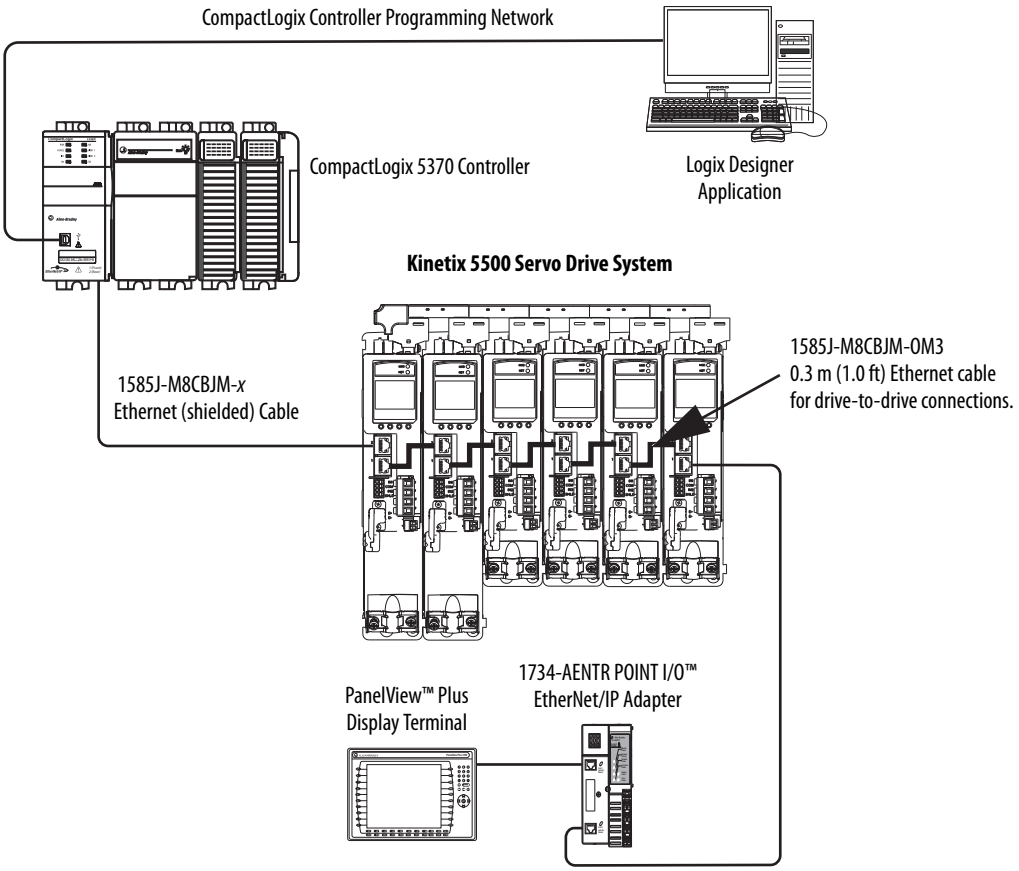
- Supports up to 16 axes
- Supports up to 48 devices in linear configurations
- Dual-port connectivity to support device-level ring (DLR) topology

Refer to CompactLogix Controllers Specifications Technical Data, publication 1769-TD005, for more information on CompactLogix 5370 L1, L2, and L3 controllers.

Linear Topology

In this example, all devices are connected in linear topology. The Kinetix 5500 drives include dual-port connectivity, however, if any device becomes disconnected, all devices downstream of that device lose communication. Devices without dual ports should include the 1783-ETAP module or be connected at the end of the line.

Figure 6 - Kinetix 5500 Linear Communication Installation

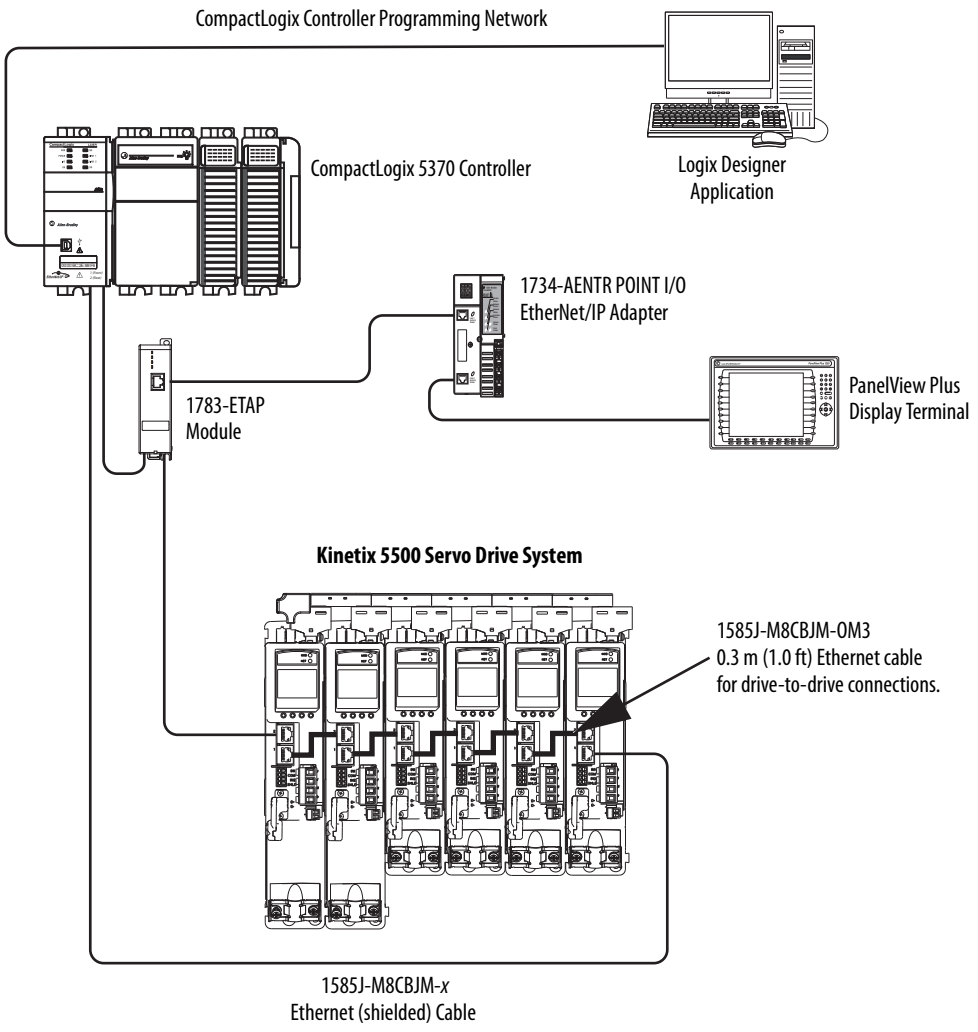

CompactLogix Controller Programming Network
CompactLogix 5370 Controller
Logix Designer Application
Kinetix 5500 Servo Drive System
1585J-M8CBJM-x Ethernet (shielded) Cable
1585J-M8CBJM-OM3 0.3 m (1.0 ft) Ethernet cable for drive-to-drive connections.
PanelView™ Plus Display Terminal
1734-AENTR POINT I/O™ EtherNet/IP Adapter

Ring Topology

In this example, the devices are connected by using ring topology. If only one device in the ring is disconnected, the rest of the devices continue to communicate. For ring topology to work correctly, a device level ring (DLR) supervisor is required (for example, the Bulletin 1783 ETAP device). DLR is an ODVA standard. For more information, refer to the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.

Devices without dual ports require a DLR supervisor, for example, the 1783-ETAP module to complete the network ring.

Figure 7 - Kinetix 5500 Ring Communication Installation

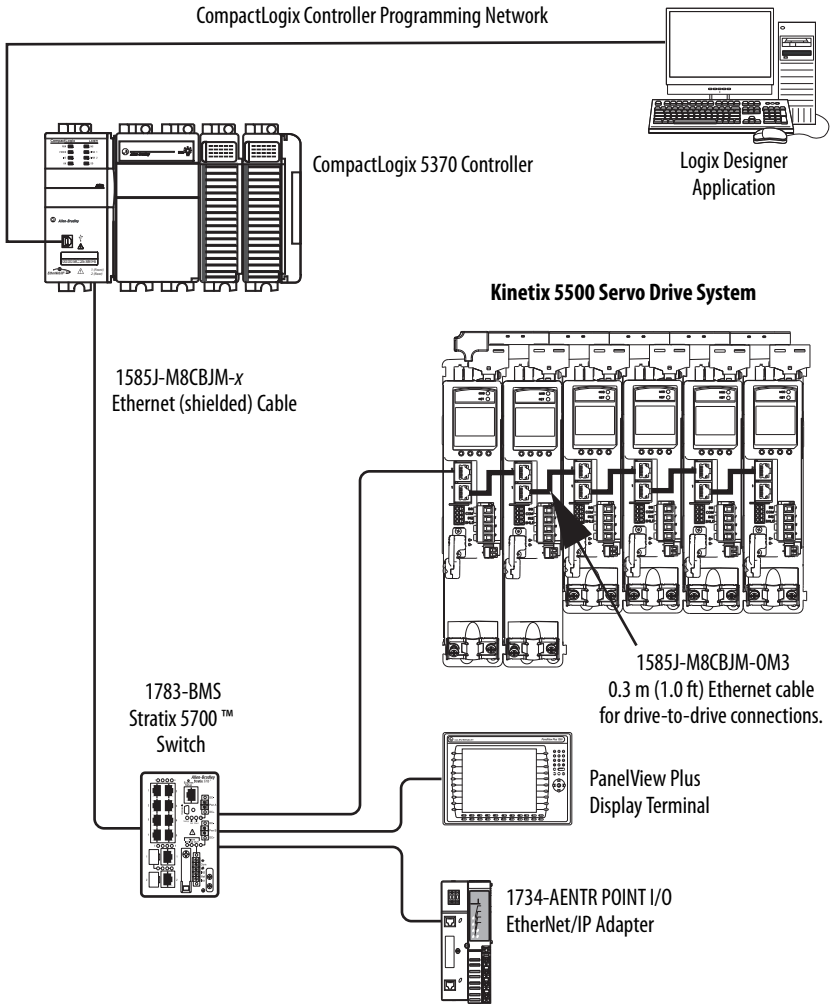

CompactLogix Controller Programming Network
CompactLogix 5370 Controller
Logix Designer Application
1734-AENTR POINT I/O EtherNet/IP Adapter
1783-ETAP Module
PanelView Plus Display Terminal
Kinetix 5500 Servo Drive System
1585J-M8CBJM-OM3 0.3 m (1.0 ft) Ethernet cable for drive-to-drive connections.
1585J-M8CBJM-x Ethernet (shielded) Cable

Star Topology

In this example, the devices are connected by using star topology. Each device is connected directly to the switch.

Kinetix 5500 drives have dual ports, so linear topology is maintained from drive-to-drive, but Kinetix 5500 drives and other devices operate independently. The loss of one device does not impact the operation of other devices.

Figure 8 - Kinetix 5500 Star Communication Installation



Catalog Number Explanation

Kinetix 5500 drive catalog numbers and performance descriptions.

Table 2 - Kinetix 5500 Drive Catalog Numbers

Kinetix 5500 Drive Cat. No.	Frame Size	Input Voltage	Continuous Output Power kW	Continuous Output Current A 0-pk
2198-H003-ERS	1	195…264V rms, single-phase 195…264V rms, three-phase 324…528V rms, three-phase	0.2 kW 0.3 kW 0.6 kW	1.4
2198-H008-ERS			0.5 kW 0.8 kW 1.6 kW	3.5
2198-H015-ERS	2		1.0 kW 1.5 KW 3.2 kW	7.1
2198-H025-ERS		195…264V rms, three-phase 324…528V rms, three-phase	2.4 kW 5.1 kW	11.3
2198-H040-ERS			4.0 kW 8.3 kW	18.4
2198-H070-ERS	3		7.0 kW 14.6 kW	32.5

Table 3 - Drive Components Catalog Numbers

Capacitor Module Cat. No.	Frame Size	Rated Voltage	Capacitance
2198-CAPMOD-1300	2	650V DC, nom	1360 µF, min

Table 4 - Shared-bus Connector Kit Catalog Numbers

Shared-bus Connector Kits Cat. No.	Frame Size	Application	Description
2198-H040-ADP-IN	1 or 2	First drive	• Mains AC input wiring connector • 24V DC input wiring connector • DC bus T connector
2198-H040-A-T	Next drive is frame 1 or 2	AC sharing only	AC bus T connector
2198-H040-D-T		DC sharing only	DC bus T connector
2198-H040-P-T		Control power sharing only	Control power T connector
2198-H040-AD-T		AC and DC bus sharing	AC and DC bus T connectors
2198-H040-AP-T		AC and control power sharing	AC and control power T connectors
2198-H040-DP-T		DC and control power sharing	DC and control power T connectors
2198-H040-ADP-T		AC, DC, and control power sharing	AC, DC, and control power T connectors
2198-H070-ADP-IN	3	First drive	• Mains AC input wiring connector • 24V DC input wiring connector • DC bus T connector
2198-H070-A-T	Next drive is frame 3	AC sharing only	AC bus T connector
2198-H070-D-T		DC sharing only	DC bus T connector
2198-H070-P-T		Control power sharing only	Control power T connector
2198-H070-AD-T		AC and DC bus sharing	AC and DC bus T connectors
2198-H070-AP-T		AC and control power sharing	AC and control power T connectors
2198-H070-DP-T		DC and control power sharing	DC and control power T connectors
2198-H070-ADP-T		AC, DC, and control power sharing	AC, DC, and control power T connectors

Agency Compliance

If this product is installed within the European Union and has the CE mark, the following regulations apply.

ATTENTION: Meeting CE requires a grounded system, and the method of grounding the AC line filter and drive must match. Failure to do this renders the filter ineffective and may cause damage to the filter. For grounding examples, refer to Grounded Power Configurations on page 63.

For more information on electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

To meet CE requirements, these requirements apply:

- Install an AC line filter (catalog number 2198-DB*xx*-F) for input power as close to the Kinetix 5500 drive as possible.
- Bond drive, capacitor module, and line filter grounding screws by using a braided ground strap as shown in Figure 36 on page 67.
- Use Bulletin 2090 single motor cables for motor power, feedback, and brake connections.
- Combined motor cable length for all axes on the same DC bus must not exceed 250 m (820 ft). Drive-to-motor cables must not exceed 50 m (164 ft).
- Install the Kinetix 5500 system inside an approved enclosure. Run input power wiring in conduit (grounded to the enclosure) outside of the enclosure. Separate signal and power cables.
- Segregate input power wiring from control wiring and motor cables.

Refer to Appendix A on page 141 for input power wiring and drive/motor interconnect diagrams.

Planning the Kinetix 5500 Drive System Installation

This chapter describes system installation guidelines used in preparation for mounting your Kinetix 5500 drive components.

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Electrical Noise Reduction	30

ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

System Design Guidelines

Use the information in this section when designing your enclosure and planning to mount your system components on the panel.

For on-line product selection and system configuration tools, including AutoCAD (DXF) drawings of the product, refer to http://www.rockwellautomation.com/en/e-tools.

System Mounting Requirements

- To comply with UL and CE requirements, the Kinetix 5500 drive systems must be enclosed in a grounded conductive enclosure offering protection as defined in standard EN 60529 (IEC 529) to IP54 such that they are not accessible to an operator or unskilled person. A NEMA 4X enclosure exceeds these requirements providing protection to IP66.
- The panel you install inside the enclosure for mounting your system components must be on a flat, rigid, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.
- Size the drive enclosure so as not to exceed the maximum ambient temperature rating. Consider heat dissipation specifications for all drive components.
- Combined motor power cable length for all axes on the same DC bus must not exceed 250 m (820 ft). Drive-to-motor power cables must not exceed 50 m (164 ft).

IMPORTANT	System performance was tested at these cable length specifications. These limitations also apply when meeting CE requirements.

- Ethernet cable lengths connecting drive-to-drive, drive-to-controller, or drive-to-switch must not exceed 100 m (328 ft).
- Registration and digital input cables greater than 30 m (98.4 ft) must be shielded.
- Segregate input power wiring from control wiring and motor cables.
- Use high-frequency (HF) bonding techniques to connect the modules, enclosure, machine frame, and motor housing, and to provide a low-impedance return path for high-frequency (HF) energy and reduce electrical noise.

  Bond drive, capacitor module, and line filter grounding screws by using a braided ground strap as shown in Figure 36 on page 67.

Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, to better understand the concept of electrical noise reduction.

Transformer Selection

The servo drive does not require an isolation transformer for three-phase input power. However, a transformer may be required to match the voltage requirements of the drive to the available service.

To size a transformer for the main AC power inputs, refer to the Kinetix 5500 power specifications in the Kinetix Servo Drives Technical Data, publication GMC-TD003.

IMPORTANT	If using an autotransformer, make sure that the phase to neutral/ground voltages do not exceed the input voltage ratings of the drive.

IMPORTANT	Use a form factor of 1.5 for three-phase power (where form factor is used to compensate for transformer, drive module, and motor losses, and to account for utilization in the intermittent operating area of the torque speed curve).

IMPORTANT	150 KVA, max and 3% impedance, min

EXAMPLE	Sizing a transformer to the voltage requirements of this drive: 2198-H040-ERS = 8.4 kW = 12.6 KVA transformer.

Circuit Breaker/Fuse Selection

The Kinetix 5500 drives use internal solid-state motor short-circuit protection and, when protected by suitable branch circuit protection, are rated for use on a circuit capable of delivering up to 150,000 A.

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses.

Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

Circuit Breaker and Fuse Specifications

Table 5 - Standalone Drive Systems

Kinetix 5500 Drive Cat. No.	Bussmann Fuses		Allen-Bradley® Circuit Breakers (1)	
	Three-phase	Single-phase	Three-phase	Single-phase
2198-H003-ERS	KTK-R-3	KTK-R-2	TBD	TBD
2198-H008-ERS	KTK-R-7	KTK-R-5	TBD	TBD
2198-H015-ERS	KTK-R-15	KTK-R-10	TBD	TBD
2198-H025-ERS	KTK-R-20	N/A	TBD	N/A
2198-H040-ERS	KTK-R-25		TBD	
2198-H070-ERS	LPJ-35SP		TBD	

(1) Circuit breakers for Kinetix 5500 drives are being evaluated.

Shared DC Drive Systems

Table 6 - Shared DC (common-bus) Drive Systems

Kinetix 5500 Drive Cat. No.	Bussmann Fuses	Allen-Bradley Circuit Breakers (1)
2198-H003-ERS	KTK-R-15	TBD
2198-H008-ERS		TBD
2198-H015-ERS		TBD
2198-H025-ERS	KTK-R-20	TBD
2198-H040-ERS	KTK-R-25	TBD
2198-H070-ERS	LPJ-35SP	TBD

(1) Circuit breakers for Kinetix 5500 drives are being evaluated.

Shared AC Drive Systems

Table 7 - Fuse Selection (Bussmann part numbers)

Kinetix 5500 Drive Cat. No.	2 Axes	3 Axes	4 Axes	5 Axes
2198-H003-ERS	KTK-R-15			
2198-H008-ERS	KTK-R-15			
2198-H015-ERS	KTK-R-20	KTK-R-25	N/A	
2198-H025-ERS	KTK-R-30		N/A	
2198-H040-ERS	LPJ-35SP	LPJ-45SP	N/A	
2198-H070-ERS	LPJ-60SP	N/A		

Table 8 - Circuit Breaker Selection (Allen-Bradley catalog numbers)

Kinetix 5500 Drive Cat. No.	2 Axes (1)	3 Axes (1)	4 Axes (1)	5 Axes (1)
2198-H003-ERS	TBD			
2198-H008-ERS	TBD			
2198-H015-ERS	TBD	TBD	N/A	
2198-H025-ERS	TBD	TBD	N/A	
2198-H040-ERS	TBD	TBD	N/A	
2198-H070-ERS	TBD	N/A		

(1) Circuit breakers for Kinetix 5500 drives are being evaluated.

Shared AC/DC and Hybrid Systems

Table 9 - Fuse Selection (Bussmann part numbers)

Kinetix 5500 Drive Cat. No.	2 Axes	3 Axes	4 Axes	5 Axes	6 Axes	7 Axes	8 Axes
2198-H003-ERS	KTK-R-10					KTK-R-15	
2198-H008-ERS	KTK-R-15				KTK-R-20		
2198-H015-ERS	KTK-R-20			N/A			
2198-H025-ERS	KTK-R-30			N/A			
2198-H040-ERS	KTK-R-30	LPJ-45SP	LPJ-50SP	N/A			
2198-H070-ERS	LPJ-50SP	N/A					

Table 10 - Circuit Breaker Selection (Allen-Bradley catalog numbers)

Kinetix 5500 Drive Cat. No.	2 Axes (1)	3 Axes (1)	4 Axes (1)	5 Axes (1)	6 Axes (1)	7 Axes (1)	8 Axes (1)
2198-H003-ERS	TBD						
2198-H008-ERS	TBD					TBD	
2198-H015-ERS	TBD	TBD		N/A			
2198-H025-ERS	TBD	TBD		N/A			
2198-H040-ERS	TBD	TBD	TBD	N/A			
2198-H070-ERS	TBD	N/A					

(1) Circuit breakers for Kinetix 5500 drives are being evaluated.

Refer to Power Wiring Examples, on page 142, for the wiring diagram.

ATTENTION: Circuit protection devices should not be used on the output of an AC drive as an isolating disconnect switch or motor overload device. These devices are designed to operate on sine wave voltage and the drive's PWM waveform does not allow it to operate properly. As a result, damage to the device will occur.

Enclosure Selection

This example is provided to assist you in sizing an enclosure for your Kinetix 5500 drive system. You need heat dissipation data from all components planned for your enclosure to calculate the enclosure size (refer to Table 11).

With no active method of heat dissipation (such as fans or air conditioning) either of the following approximate equations can be used.

Metric	Standard English
$A = \frac{0.38Q}{1.8T - 1.1}$	$A = \frac{4.08Q}{T - 1.1}$
Where T is temperature difference between inside air and outside ambient (°C), Q is heat generated in enclosure (Watts), and A is enclosure surface area (m^2). The exterior surface of all six sides of an enclosure is calculated as	Where T is temperature difference between inside air and outside ambient (°F), Q is heat generated in enclosure (Watts), and A is enclosure surface area (ft^2). The exterior surface of all six sides of an enclosure is calculated as
$A = 2dw + 2dh + 2wh$	$A = (2dw + 2dh + 2wh) / 144$
Where d (depth), w (width), and h (height) are in meters.	Where d (depth), w (width), and h (height) are in inches.

If the maximum ambient rating of the Kinetix 5500 drive system is 50 °C (122 °F) and if the maximum environmental temperature is 20 °C (68 °F), then T=30. In this example, the total heat dissipation is 416 W (sum of all components in enclosure). So, in the equation below, T=30 and Q=416.

$$A = \frac{0.38\,(416)}{1.8\,(30) - 1.1} = 2.99\,m^2$$

In this example, the enclosure must have an exterior surface of at least 2.99 m^2. If any portion of the enclosure is not able to transfer heat, it should not be included in the calculation.

Because the minimum cabinet depth to house the Kinetix 5500 system (selected for this example) is 300 mm (11.8 in.), the cabinet needs to be approximately 1500 x 700 x 300 mm (59.0 x 27.6 x 11.8 in.) HxWxD.

$$1.5 \times (0.300 \times 0.70) + 1.5 \times (0.300 \times 2.0) + 1.5 \times (0.70 \times 2.0) = 3.31\,m^2$$

Because this cabinet size is considerably larger than what is necessary to house the system components, it may be more efficient to provide a means of cooling in a smaller cabinet. Contact your cabinet manufacturer for options available to cool your cabinet.

Table 11 - Power Dissipation Specifications

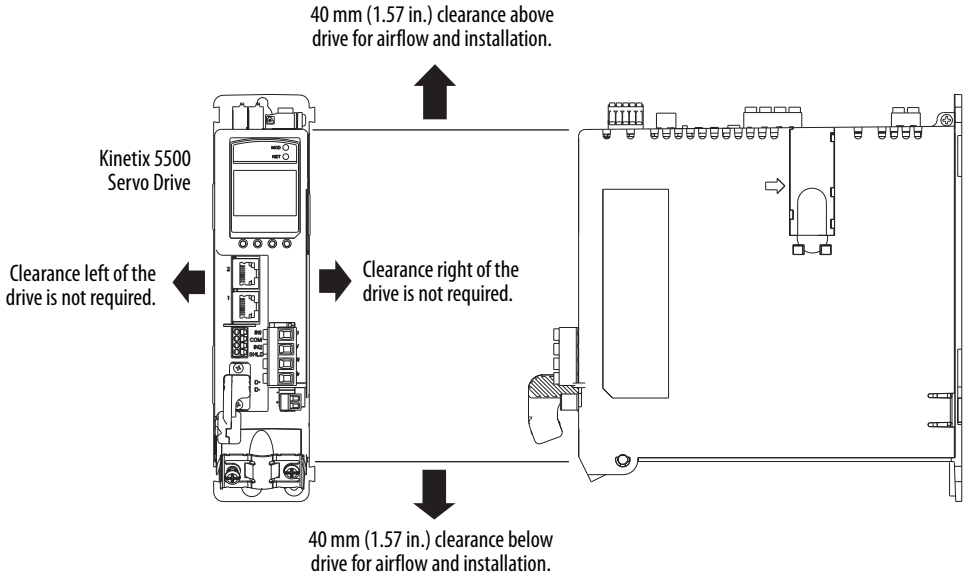
Kinetix 5500 Drive Cat. No.	Frame Size	Usage as % of Rated Power Output (watts)				
		20%	40%	60%	80%	100%
2198-H003-ERS	1	12	25	37	50	62
2198-H008-ERS						
2198-H015-ERS	2	40	80	120	160	200
2198-H025-ERS						
2198-H040-ERS						
2198-H070-ERS	3	64	128	192	256	320

Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Kinetix 5500 drive:

- Additional clearance is required for cables and wires or the shared-bus connection system connected to the top of the drive.
- Additional clearance is required if other devices are installed above and/or below the drive and have clearance requirements of their own.
- Additional clearance left and right of the drive is required when mounted adjacent to noise sensitive equipment or clean wire ways.
- The recommended minimum cabinet depth is 300 mm (11.81 in.).

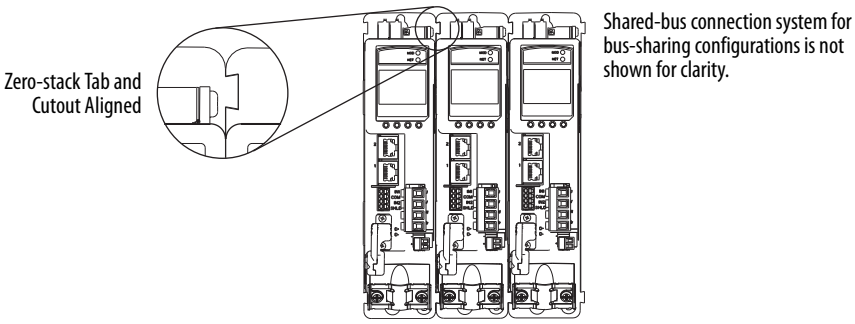
Figure 9 - Minimum Clearance Requirements


40 mm (1.57 in.) clearance above drive for airflow and installation.
Kinetix 5500 Servo Drive
Clearance left of the drive is not required.
Clearance right of the drive is not required.
40 mm (1.57 in.) clearance below drive for airflow and installation.

IMPORTANT Mount the drive in an upright position as shown. Do not mount the drive on its side.

In multi-axis shared-bus configurations, drives must be spaced by aligning the zero-stack tab and cutout.

Figure 10 - Multi-axis Shared-bus Clearance Requirements


Zero-stack Tab and Cutout Aligned
Shared-bus connection system for bus-sharing configurations is not shown for clarity.

Electrical Noise Reduction

This section outlines best practices that minimize the possibility of noise-related failures as they apply specifically to Kinetix 5500 system installations. For more information on the concept of high-frequency (HF) bonding, the ground plane principle, and electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Bonding Modules

Bonding is the practice of connecting metal chassis, assemblies, frames, shields, and enclosures to reduce the effects of electromagnetic interference (EMI).

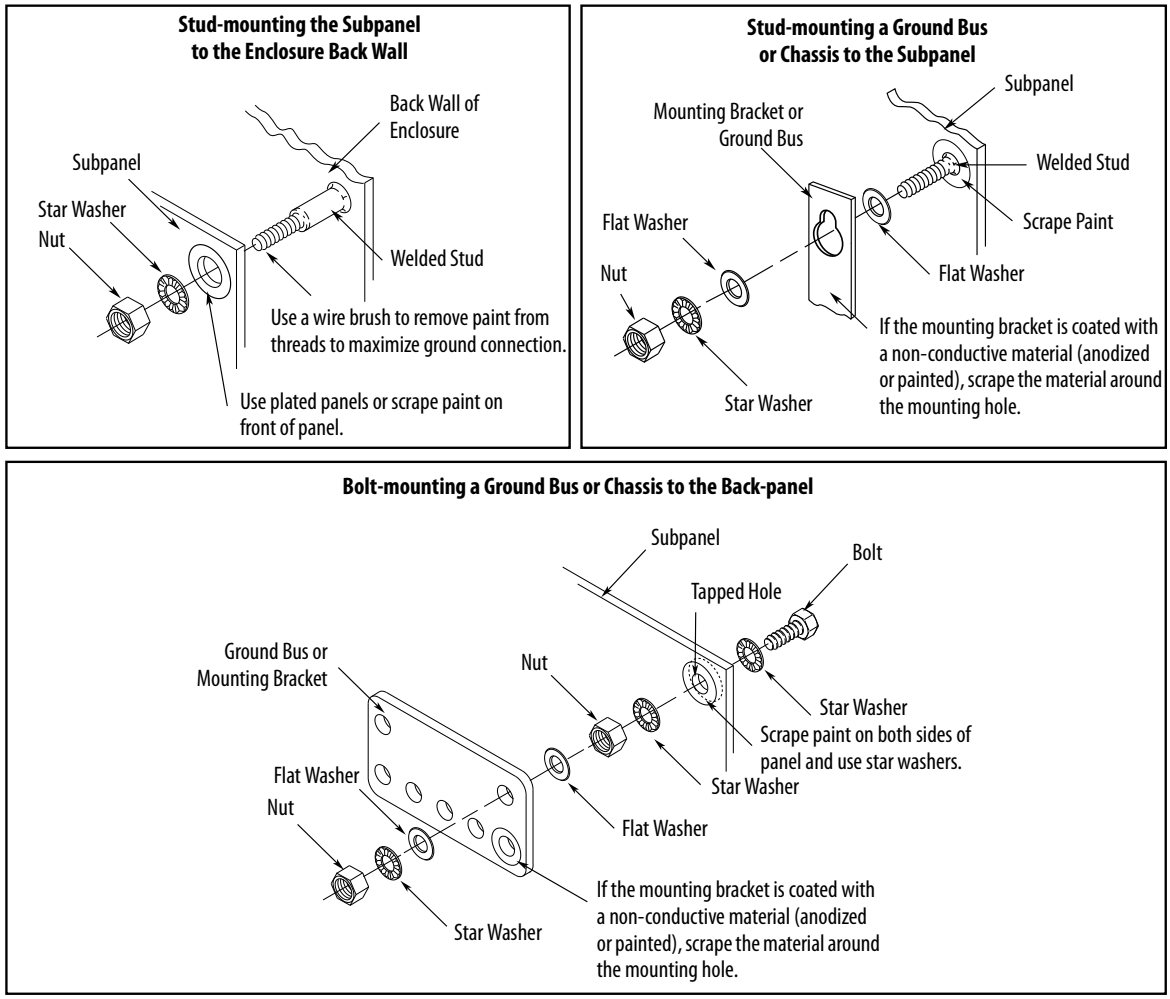
Unless specified, most paints are not conductive and act as insulators. To achieve a good bond between power rail and the subpanel, surfaces need to be paint-free or plated. Bonding metal surfaces creates a low-impedance return path for high-frequency energy.

IMPORTANT To improve the bond between the power rail and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

Improper bonding of metal surfaces blocks the direct return path and allows high-frequency energy to travel elsewhere in the cabinet. Excessive high-frequency energy can effect the operation of other microprocessor controlled equipment.

These illustrations show details of recommended bonding practices for painted panels, enclosures, and mounting brackets.

Figure 11 - Recommended Bonding Practices for Painted Panels

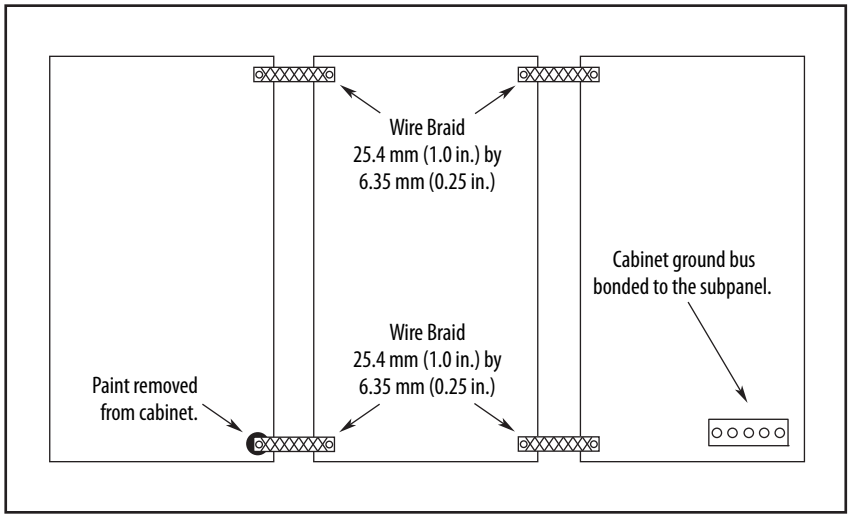

Stud-mounting the Subpanel to the Enclosure Back Wall
Back Wall of Enclosure
Subpanel
Star Washer
Nut
Welded Stud
Use a wire brush to remove paint from threads to maximize ground connection.
Use plated panels or scrape paint on front of panel.
Stud-mounting a Ground Bus or Chassis to the Subpanel
Subpanel
Mounting Bracket or Ground Bus
Welded Stud
Scrape Paint
Flat Washer
Nut
Flat Washer
If the mounting bracket is coated with a non-conductive material (anodized or painted), scrape the material around the mounting hole.
Star Washer
Bolt-mounting a Ground Bus or Chassis to the Back-panel
Subpanel
Bolt
Tapped Hole
Ground Bus or Mounting Bracket
Nut
Star Washer
Scrape paint on both sides of panel and use star washers.
Flat Washer
Nut
Star Washer
Flat Washer
If the mounting bracket is coated with a non-conductive material (anodized or painted), scrape the material around the mounting hole.
Star Washer

Bonding Multiple Subpanels

Bonding multiple subpanels creates a common low impedance exit path for the high frequency energy inside the cabinet. Subpanels that are not bonded together may not share a common low impedance path. This difference in impedance may affect networks and other devices that span multiple panels:

- Bond the top and bottom of each subpanel to the cabinet by using 25.4 mm (1.0 in.) by 6.35 mm (0.25 in.) wire braid. As a rule, the wider and shorter the braid is, the better the bond.
- Scrape the paint from around each fastener to maximize metal-to-metal contact.

Figure 12 - Multiple Subpanels and Cabinet Recommendations

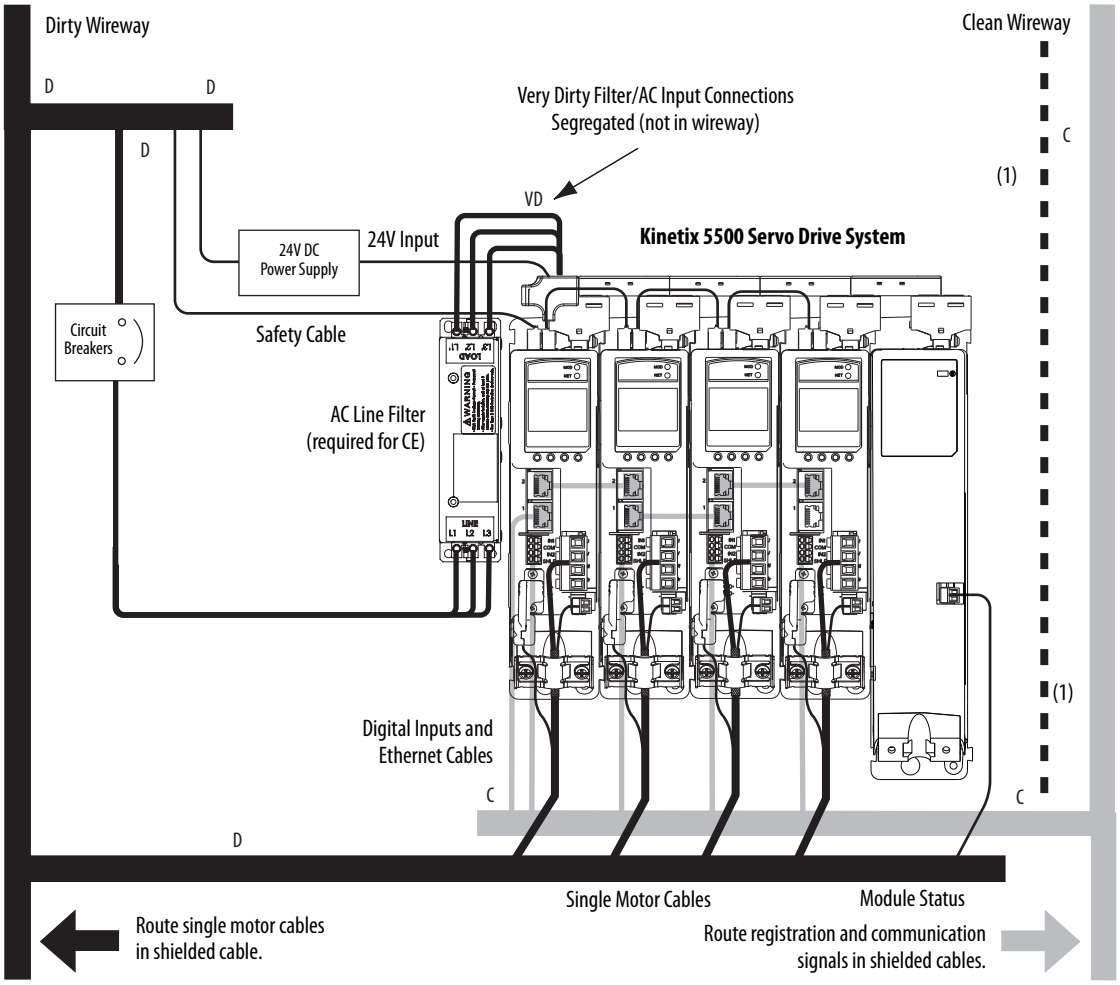


Establishing Noise Zones

Observe these guidelines when routing cables used in the Kinetix 5500 system:

- The clean zone (C) is beneath the drive system and includes the digital inputs wiring and Ethernet cable (gray wireway).
- The dirty zone (D) is above and below the drive system (black wireways) and includes the circuit breakers, 24V DC power supply, safety, and motor cables.
- The very dirty zone (VD) is limited to where the AC line (EMC) filter VAC output jumpers over to the drive (or first drive in multi-axis systems). Shielded cable is required only if the very dirty cables enter a wireway.

Figure 13 - Noise Zones



(1) When space to the right of the drive does not permit 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Cable Categories for Kinetix 5500 Systems

These tables indicate the zoning requirements of cables connecting to the Kinetix 5500 drive components.

Table 12 - Kinetix 5500 Drive

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
L1, L2, L3 (shielded cable)	IPD		X			X
L1, L2, L3 (unshielded cable)		X				
DC-/DC+ (DC bus)	DC	Bus-bar only, no wiring connector				
DC+/SH (shunt)	RC		X			
U, V, W (motor power) Motor feedback Motor brake	MP MF BC		X			X
24V DC	CP		X			
Safety enable for safe torque-off	STO		X			
Registration input, greater than 30 m (98.4 ft)	IOD			X		X
Registration input, less than 30 m (98.4 ft)				X		
Ethernet	PORT1 PORT2			X		X

Table 13 - Capacitor Module

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
DC-/DC+ (DC bus)	DC	Bus-bar only, no wiring connector.				
24V DC	CP	Bus-bar only, no wiring connector.				
Module status	MS		X			

Noise Reduction Guidelines for Drive Accessories

Refer to this section when mounting an AC (EMC) line filter or external shunt resistor for guidelines designed to reduce system failures caused by excessive electrical noise.

AC Line Filters

Observe these guidelines when mounting your AC (EMC) line filter (refer to the figure on page 33 for an example):

- Mount the AC line filter on the same panel as the Kinetix 5500 drive and as close to the power rail as possible.
- Good HF bonding to the panel is critical. For painted panels, refer to the examples on page 31.
- Segregate input and output wiring as far as possible.

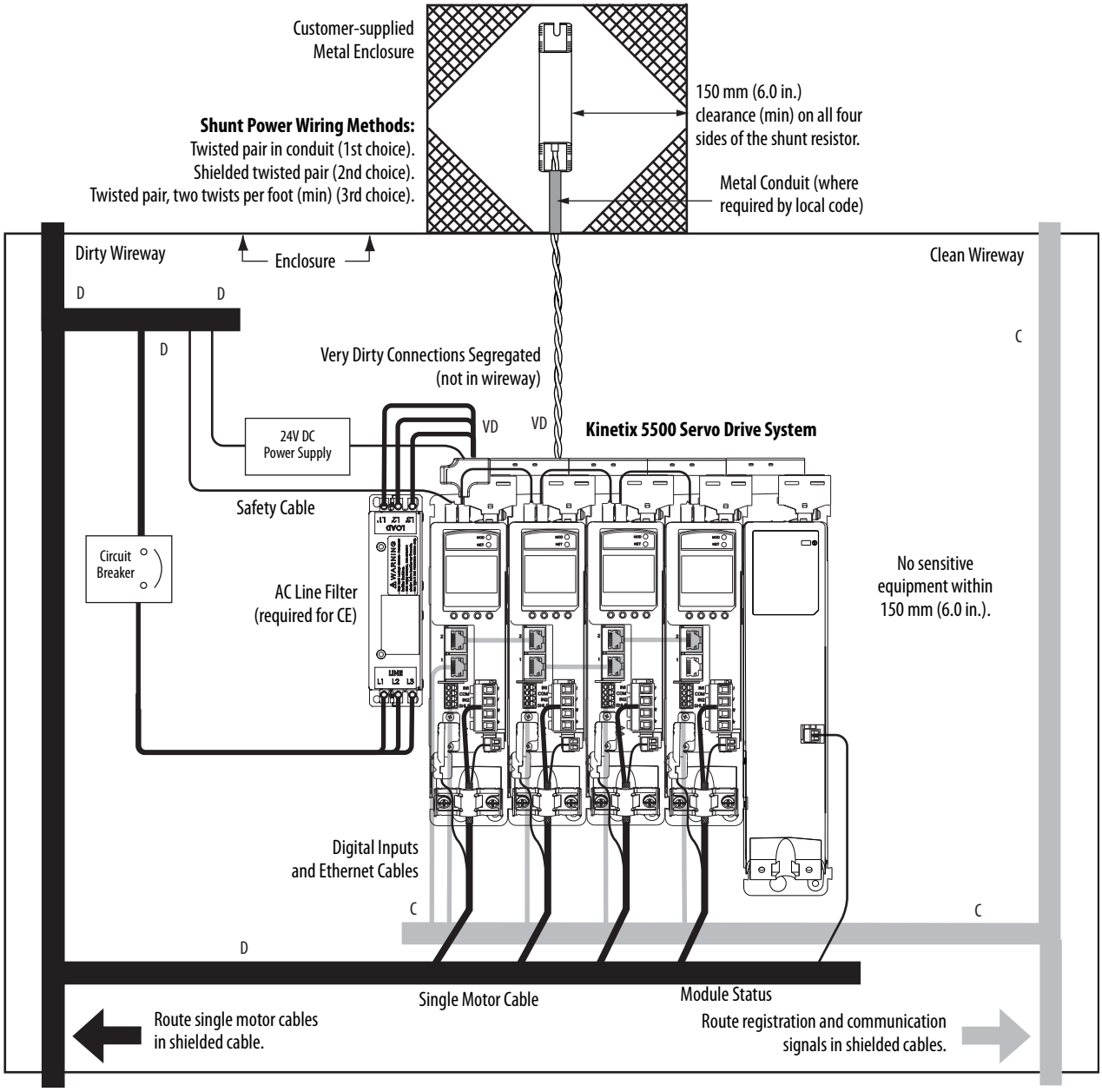
IMPORTANT CE test certification applies only to AC line filter used with single drives or line filter used with multi-axis drive configurations. Sharing a line filter with more than one configuration may perform satisfactorily, but the customer takes legal responsibility.

External Shunt Resistor

Observe these guidelines when mounting your external shunt resistor outside of the enclosure:

- Mount shunt resistor and wiring in the very dirty zone or in an external shielded enclosure.
- Mount resistors in a shielded and ventilated enclosure outside of the cabinet.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.

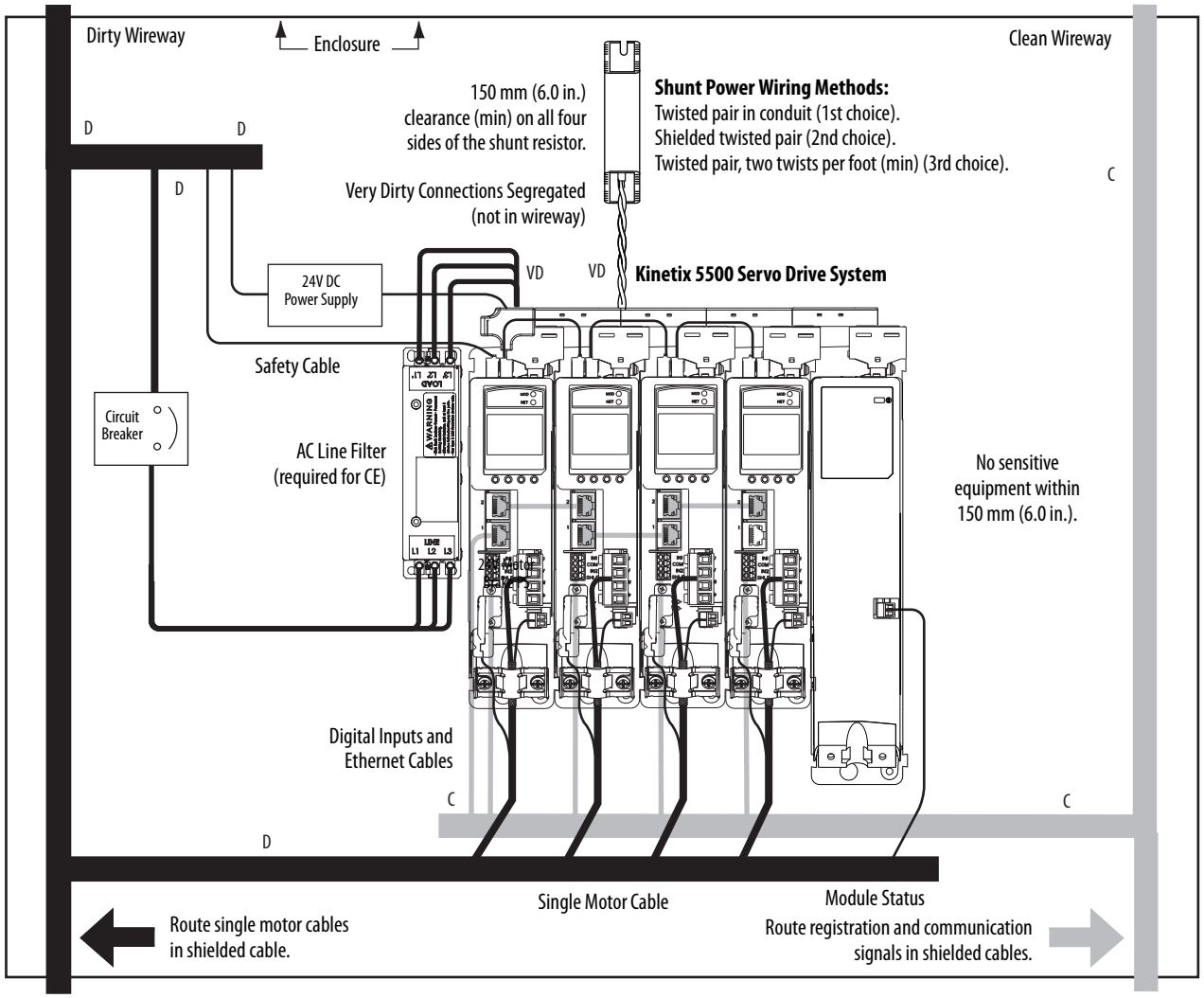
Figure 14 - External Shunt Resistor Outside the Enclosure



When mounting your shunt resistor inside the enclosure, follow these additional guidelines:

- Mount metal-clad modules anywhere in the dirty zone, but as close to the Kinetix 5500 drive as possible.
- Route shunt power wires with other very dirty wires.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Separate shunt power cables from other sensitive, low voltage signal cables.

Figure 15 - External Shunt Resistor Inside the Enclosure


Dirty Wireway
Enclosure
Clean Wireway
150 mm (6.0 in.) clearance (min) on all four sides of the shunt resistor.
Shunt Power Wiring Methods:
Twisted pair in conduit (1st choice).
Shielded twisted pair (2nd choice).
Twisted pair, two twists per foot (min) (3rd choice).
Very Dirty Connections Segregated (not in wireway)
24V DC Power Supply
VD
VD
Kinetix 5500 Servo Drive System
Safety Cable
Circuit Breaker
AC Line Filter (required for CE)
No sensitive equipment within 150 mm (6.0 in.).
Digital Inputs and Ethernet Cables
Single Motor Cable
Module Status
Route single motor cables in shielded cable.
Route registration and communication signals in shielded cables.
D
C

Notes:

Mounting the Kinetix 5500 Drive System

This chapter provides the system installation procedures for mounting your Kinetix 5500 drives to the system panel.

Topic	Page
Determining Mounting Order	40
Drilling Hole Patterns	43
Mount Your Kinetix 5500 Drive	50

This procedure assumes you have prepared your panel and understand how to bond your system. For installation instructions regarding equipment and accessories not included here, refer to the instructions that came with those products.

SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Kinetix 5500 drives prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

Determining Mounting Order

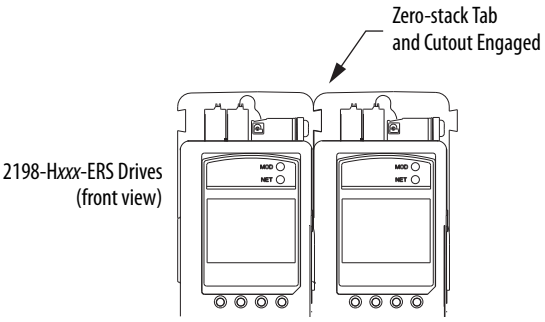
Mount drives in order (left to right) according to power rating (highest to lowest) starting with the highest power rating. If power rating is unknown, position drives (highest to lowest) from left to right based on amp rating.

Zero-stack Tab and Cutout

Engaging the zero-stack tab and cutout from drive-to-drive makes efficient use of panel space for installations with multiple drives.

IMPORTANT	Engaging the zero-stack tab and cutout from drive-to-drive is required for shared-bus multi-axis drive systems. This is done to make sure the drive connectors are spaced properly to accept the shared-bus connection system.

Figure 16 - Zero-stack Tab and Cutout Example

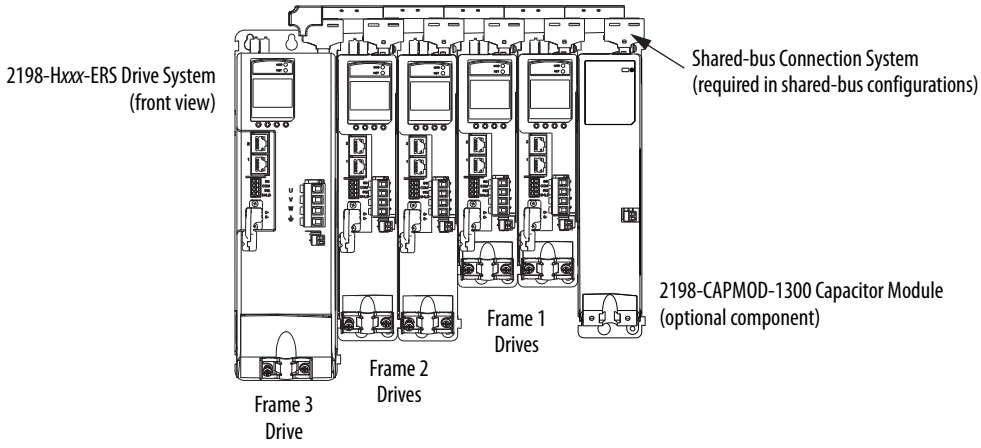


For the zero-stack feature to engage properly (when more than one frame size exists in the drive system) frame 3 drives must mount left of frame 1 or 2 drives, and frame 2 drives must mount left of frame 1 drives.

Capacitor modules can mount to the right of any frame size, but are always rightmost in any drive configuration.

IMPORTANT	Mount drives in descending order, left to right, according to frame size with capacitor modules always mounted on the far right.

Figure 17 - Shared-bus Connection System Example



Shared-bus Connection System

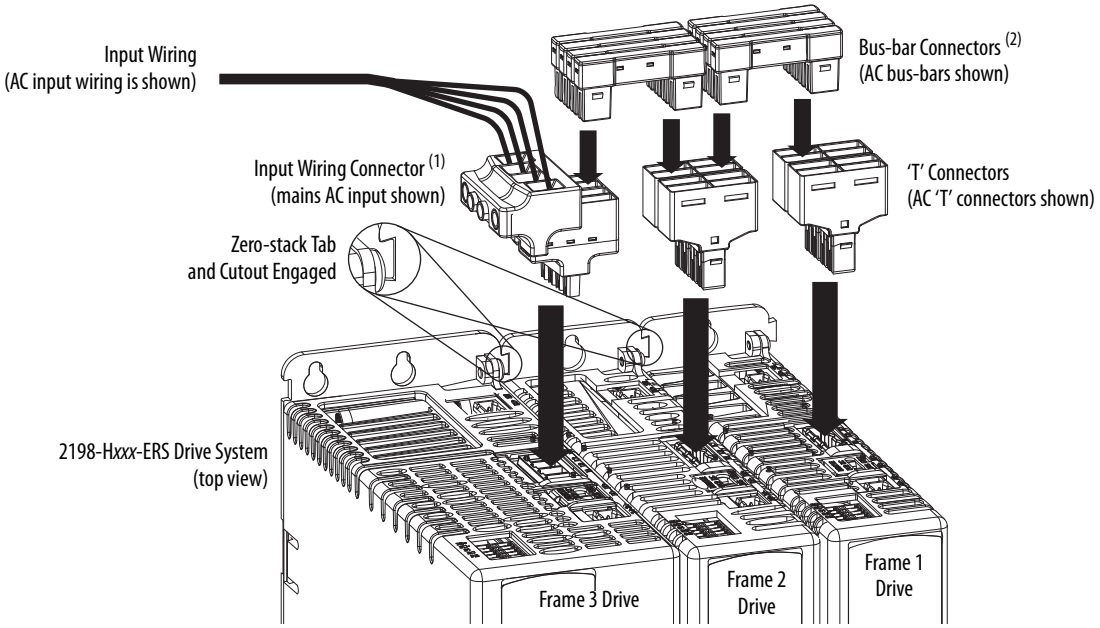
The shared-bus connection system is used to extend the mains AC input, 24V control input, and the DC bus power from drive-to-drive in shared-bus multi-axis configurations.

IMPORTANT	When the shared-bus connection system is used, the zero-stack tab and cutout must be engaged between adjacent drives.

The connection system is comprised of three components:

- Input wiring connectors that plug into the leftmost drive and receive input wiring for mains AC and 24V DC.
- AC bus, DC bus, and 24V DC 'T' connectors that plug into the drives downstream from the first where AC, DC, and/or 24V control power is shared. DC bus 'T' connectors also plug into the first drive where DC bus power is shared.
- Bus bars that connect between drives to extend the mains AC bus, DC bus, and 24V DC control power from drive-to-drive.

Figure 18 - Connection System Example



(1) Due to the higher amp rating of frame 3 drives, input wiring connectors for frame 3 drives (catalog number 2198-H070-ADP-IN) are slightly larger than connectors for frame 1 and 2 drives (catalog number 2198-H040-ADP-IN).

(2) Due to the extra width of frame 3 drives, bus-bar connectors between frame 3 drives are slightly longer (85 mm) than connectors between frame 3, 2, and 1 drives (55 mm).

The three components assemble from left to right across the drive system.

1. Attach wiring to input wiring connectors.
2. Insert input wiring connectors and 'T' connectors into the appropriate drive connectors.
3. Insert bus-bars to connect between wiring connectors and 'T' connectors.

Single-axis Configurations

The following restrictions exist for standalone (single-axis) configurations:

- Standalone (single-axis) drives can be mounted to the panel individually or by using the zero-stack tab and cutout (refer to Figure on page 41)
- The shared-bus connection system does not apply and should not be used

For a single-axis example configuration, refer to Typical Kinetix 5500 Standalone Installation on page 13.

Multi-axis Configurations

Each multi-axis configuration has restrictions that apply:

- The shared-bus connection system must be used. Do not attach discrete wires from drive-to-drive.
- The maximum number of drives in Shared AC bus power-sharing groups cannot exceed 5.
- The maximum number of drives in any other bus power-sharing group cannot exceed 8.

For a multi-axis example configuration, refer to Typical Shared AC/DC Bus Hybrid Installations on page 17.

Drilling Hole Patterns

Hole patterns for drives mounted in zero-stack or shared-bus configuration are provided for mounting your drives to the panel. Drives with the highest power rating are always mounted to the left of any drive with a lower power rating in shared-bus configurations:

- Frame 1 drives can only be followed by another frame 1 drive.
- Frame 2 drives can be followed by frame 1 drives or another frame 2 drive.
- Frame 3 drives can be followed by frame 1, frame 2, or another frame 3 drive.
- Mount Bulletin 2198 capacitor modules in the rightmost position.
  - Capacitor modules have the same hole pattern as frame 2 drives.
  - Only Shared DC, Shared AC/DC, and Shared AC/DC, hybrid configurations are compatible with Bulletin 2198 capacitor modules.

Table 14 - Hole Pattern Overview

Drive Cat. No.	Frame Size	Frame Size Patterns	Page
2198-H003-ERS 2198-H008-ERS	Frame 1	As many as eight frame 1 drives	45
2198-H015-ERS 2198-H025-ERS 2198-H040-ERS	Frame 2	As many as 8 frame 2 drives	
		One frame 2 drive followed by as many as seven frame 1 drives	46
2198-H070-ERS	Frame 3	As many as 8 frame 3 drives	47
		One frame 3 drive followed by as many as seven frame 1 drives	48
		One frame 3 drive followed by as many as seven frame 2 drives	49

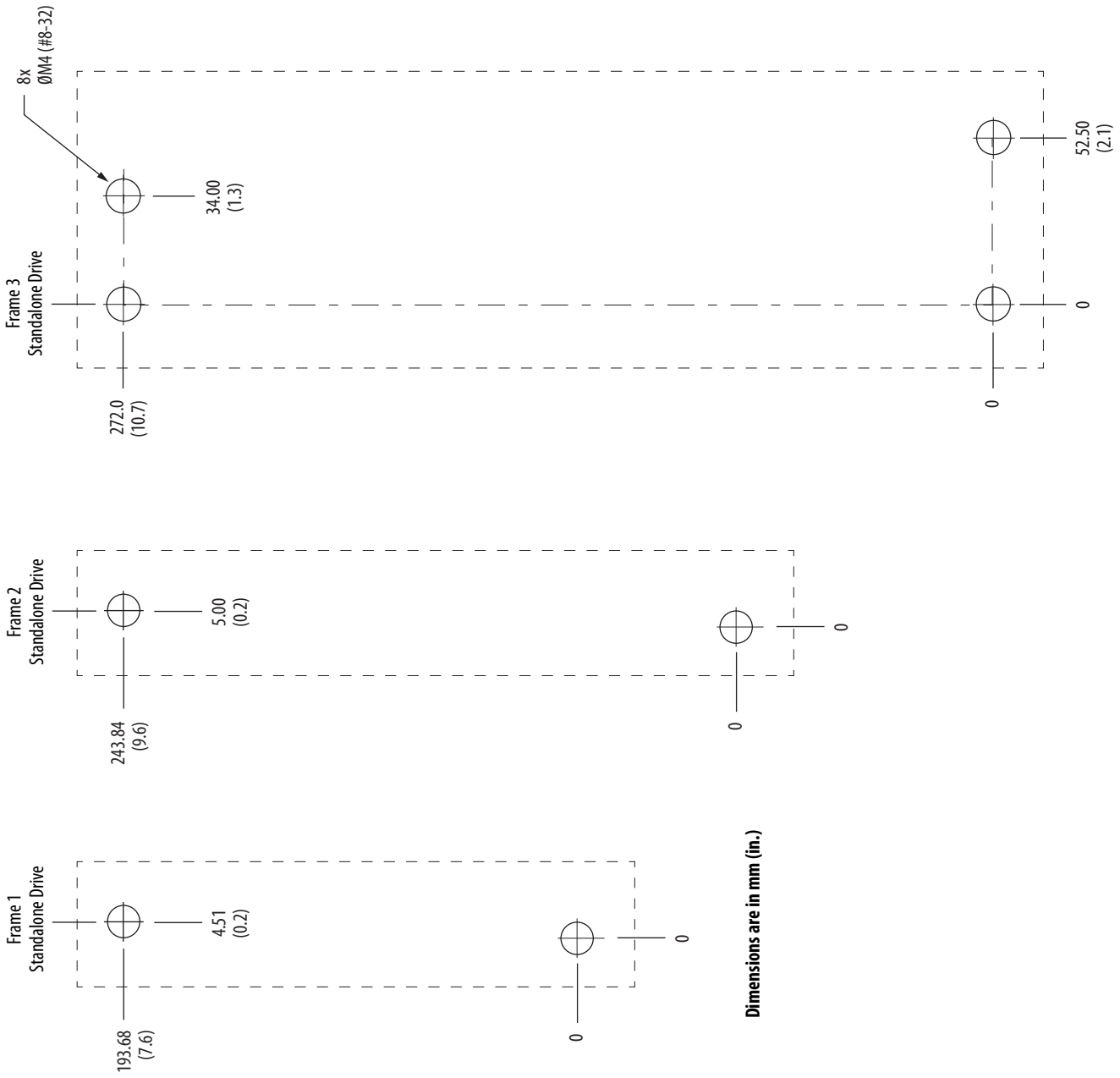
Table 15 - Capacitor Module Support

Drive Cat. No.	Frame Size	Standalone Single Phase Operation	Three-phase Operation			
			Standalone	Shared DC	Shared AC/DC	Shared AC/DC Hybrid
		Number of capacitor modules connected, max				
2198-H003-ERS (1)	1	0	0			
2198-H008-ERS (1)			1		2	
2198-H015-ERS (1)	2					
2198-H025-ERS		N/A	3		4	
2198-H040-ERS						
2198-H070-ERS	3		4			

(1) Catalog number 2198-H003-ERS and any drive in standalone single-phase operation is not compatible with the Kinetix 5500 capacitor module.

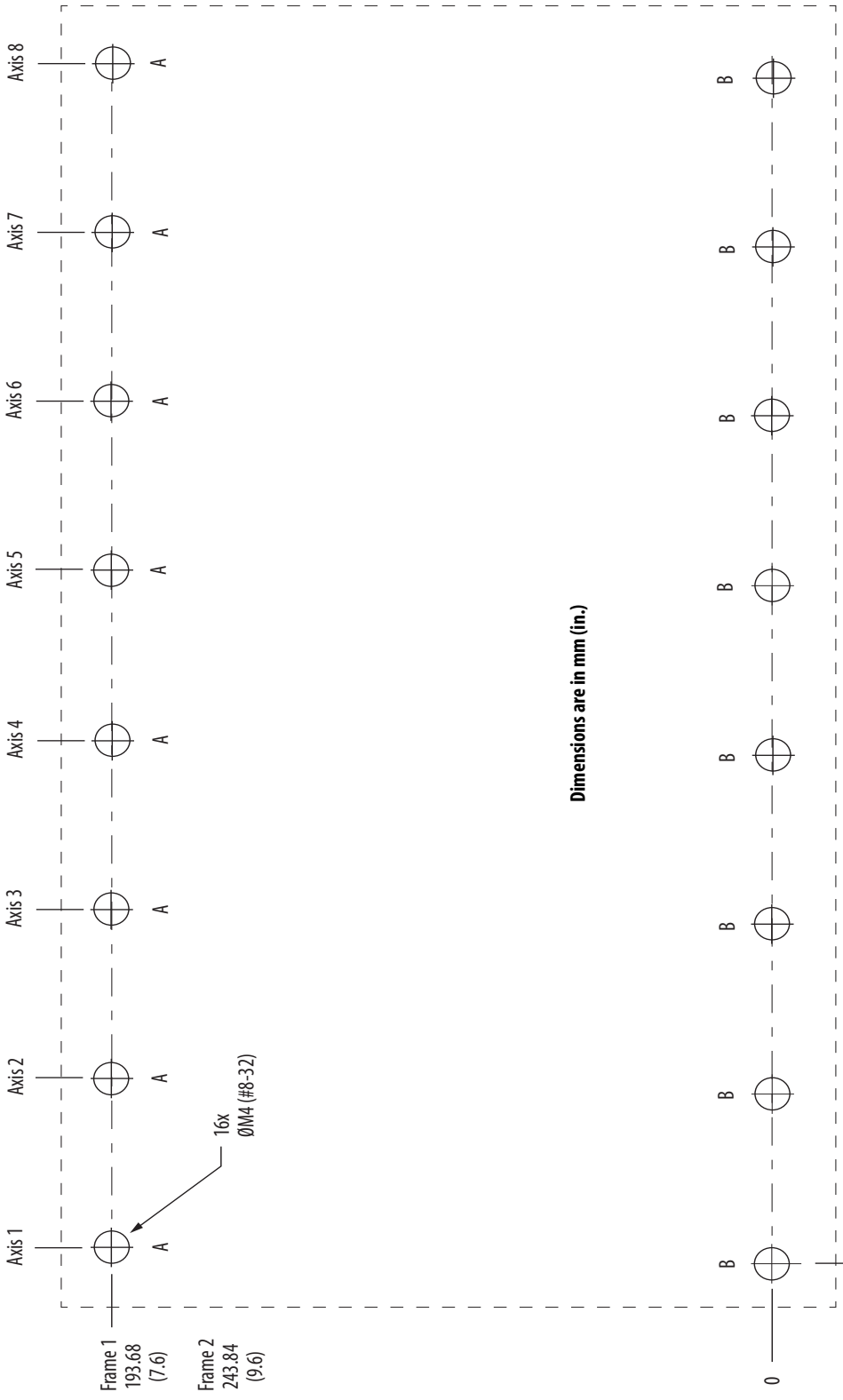
These hole patterns apply to standalone drives.

Figure 19 - Frame 1, Frame 2, and Frame 3 Standalone Hole Patterns



These hole patterns apply when all drives in the system are frame 1 or frame 2. You can also use these patterns when transitioning from frame 2 to frame 1.

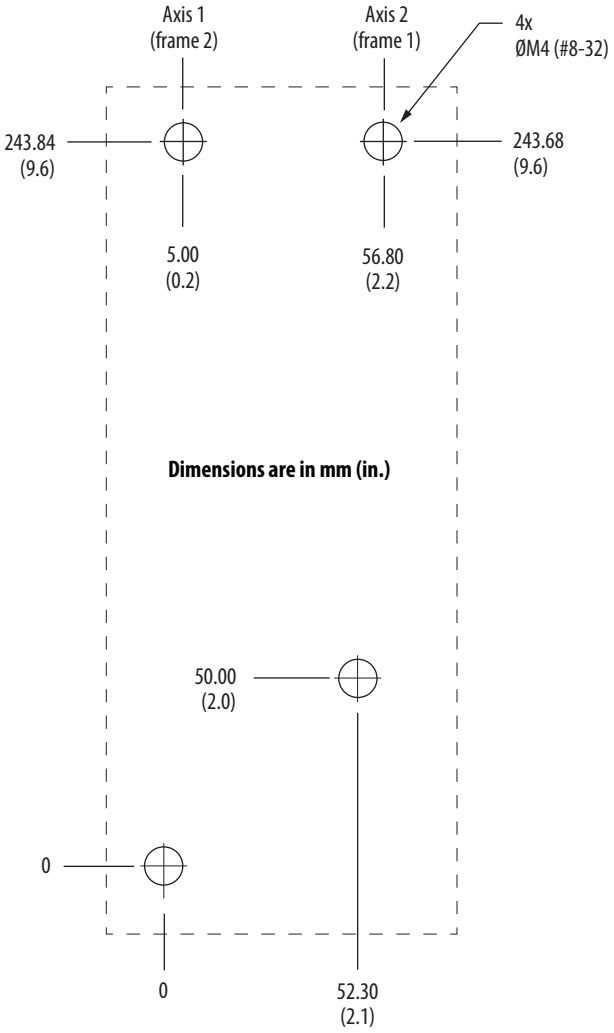
Figure 20 - Frame 1 and Frame 2 Hole Patterns



Frame Size	Dimension	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
1	A	4.51 (0.2)	54.38 (2.1)	104.26 (4.1)	154.14 (6.1)	204.02 (8.0)	253.90 (10.0)	303.78 (12.0)	353.66 (13.9)
	B	0	49.88 (2.0)	99.75 (3.9)	149.63 (5.9)	199.51 (7.9)	249.39 (9.8)	299.27 (11.8)	349.15 (13.7)
2	A	5.00 (0.2)	59.70 (2.4)	114.40 (4.5)	169.10 (6.7)	223.80 (8.8)	278.50 (11.00)	333.20 (13.1)	387.90 (15.3)
	B	0	54.70 (2.2)	109.40 (4.3)	164.10 (6.5)	218.80 (8.6)	273.50 (10.8)	328.20 (12.9)	382.90 (15.1)

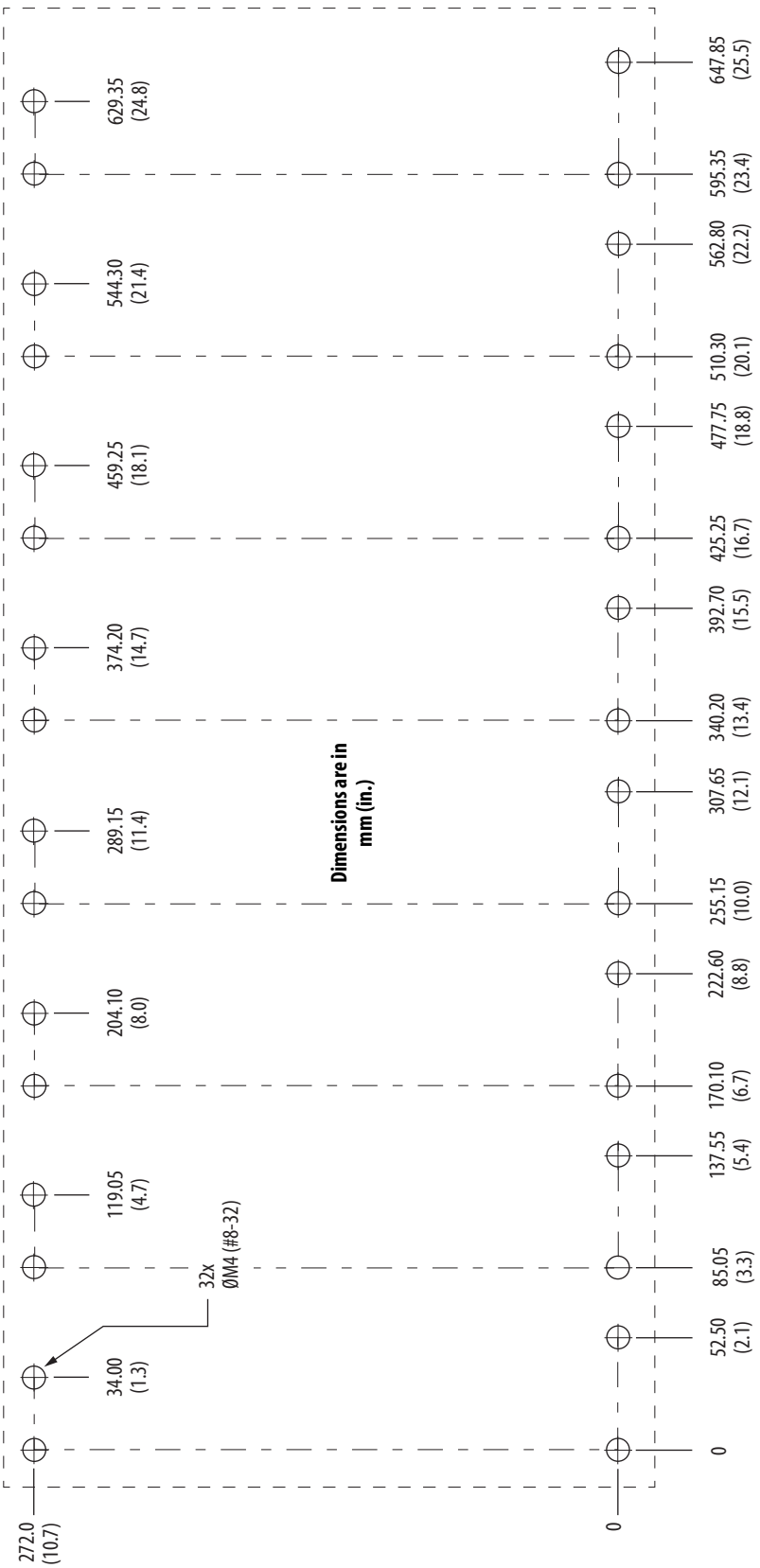
This hole pattern applies when transitioning from frame 2 to frame 1 drives. For additional frame 1 drives mounted to the right of Axis 2 in this figure, use the Frame 1 hole pattern in Figure 20 and reassign Axis 2 as Axis 1.

Figure 21 - Frame 2 to Frame 1 Hole Pattern



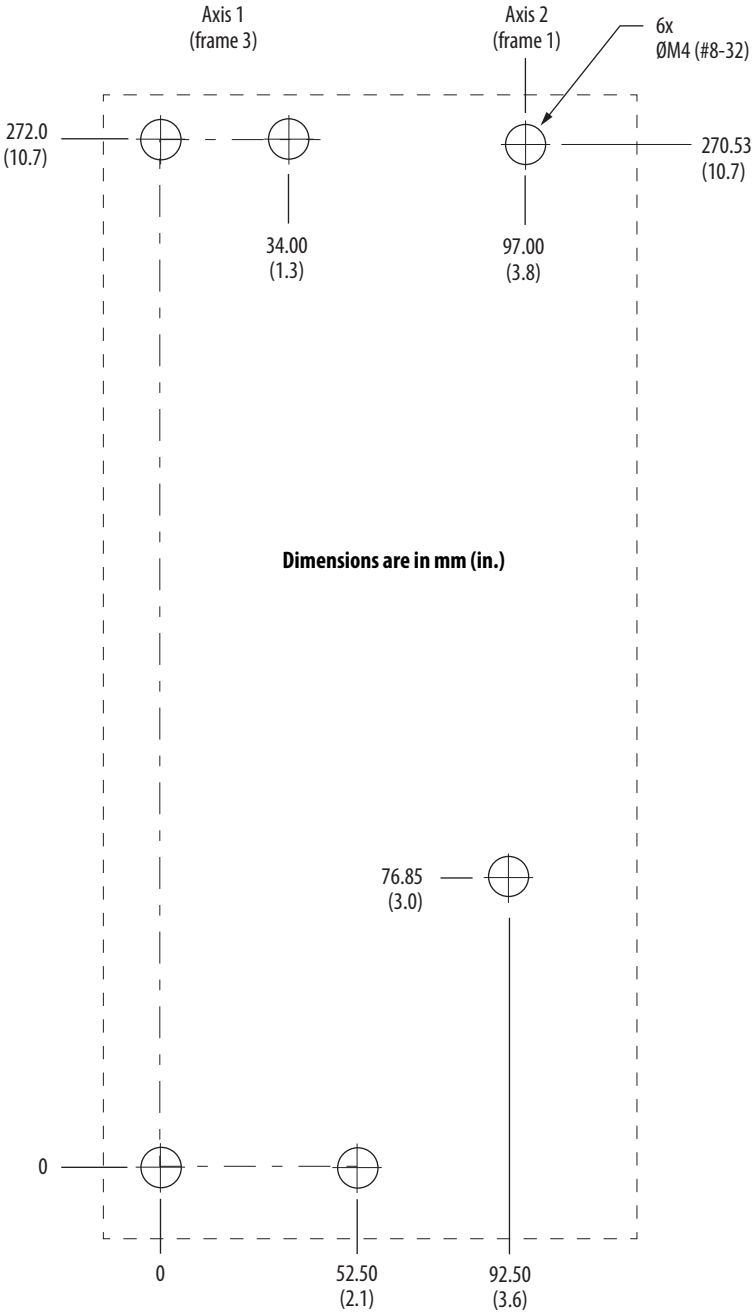
This hole pattern applies when all drives in the system are frame 3.

Figure 22 - Frame 3 Hole Pattern



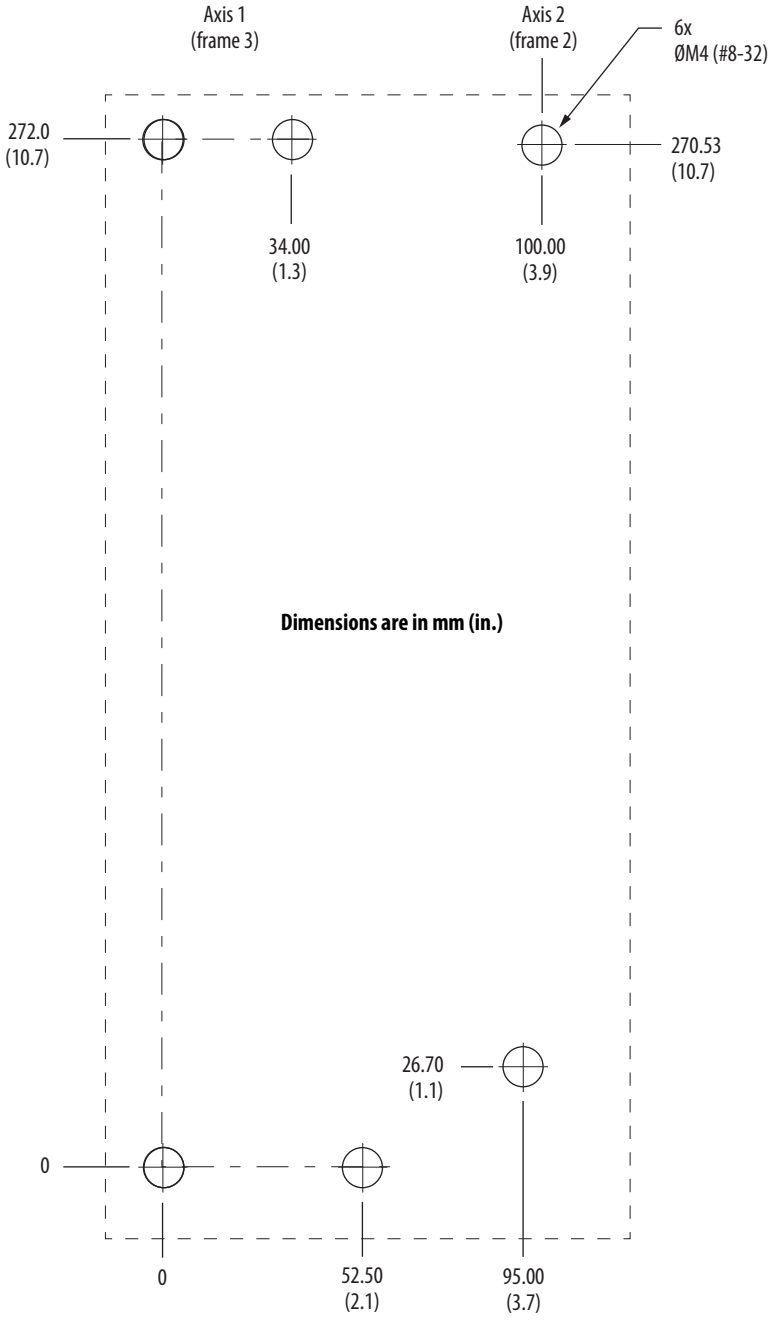
This hole pattern applies when transitioning from frame 3 drives to frame 1 drives. For additional frame 1 drives mounted to the right of Axis 2 in this figure, use the Frame 1 hole pattern in Figure 20 and reassign Axis 2 as Axis 1.

Figure 23 - Frame 3 to Frame 1 Hole Pattern



This hole pattern applies when transitioning from frame 3 drives to frame 2 drives. For additional frame 2 drives mounted to the right of Axis 2 in this figure, use the Frame 2 hole pattern in Figure 20 and reassign Axis 2 as Axis 1.

Figure 24 - Frame 3 to Frame 2 Hole Pattern



Mount Your Kinetix 5500 Drive

This procedure assumes you have prepared your panel and understand how to bond your system. For installation instructions regarding other equipment and accessories, refer to the instructions that came with those products.

Follow these steps to mount your Kinetix 5500 drives to the panel.

1. Lay out the hole pattern for each Kinetix 5500 drive in the enclosure.

   Refer to Establishing Noise Zones on page 33 for panel layout recommendations.

   IMPORTANT To improve the bond between the Kinetix 5500 drive and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

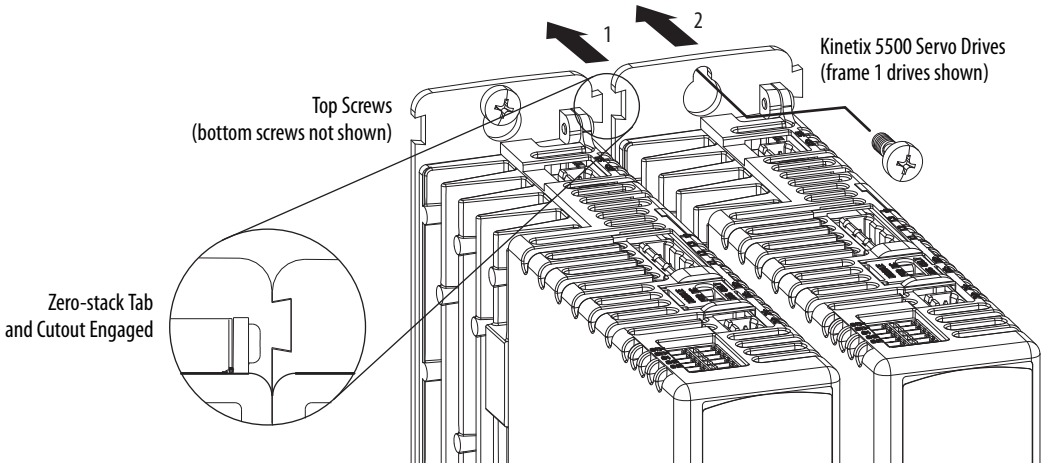
2. Drill holes in the panel for mounting your drive system.

   Hole patterns, by frame size, are shown in Drilling Hole Patterns beginning on page 43.

3. Loosely attach the mounting hardware to the panel.

   The recommended mounting hardware is M4 (#8-32) steel bolts. Observe bonding techniques as described in Bonding Modules on page 30.

4. Attach the leftmost drive to the cabinet panel.



5. Attach additional drives (if any) just to the right of the previous drive by using the same method, but also making sure the zero-stack tabs and cutouts are engaged.

   Zero-stack mounting is required based on configuration, refer to the Zero-stack Tab and Cutout Example on page 40.

6. Tighten all mounting fasteners.

   Apply 2.0 N•m (17.7 lb•in) maximum torque to each fastener.

Connector Data and Feature Descriptions

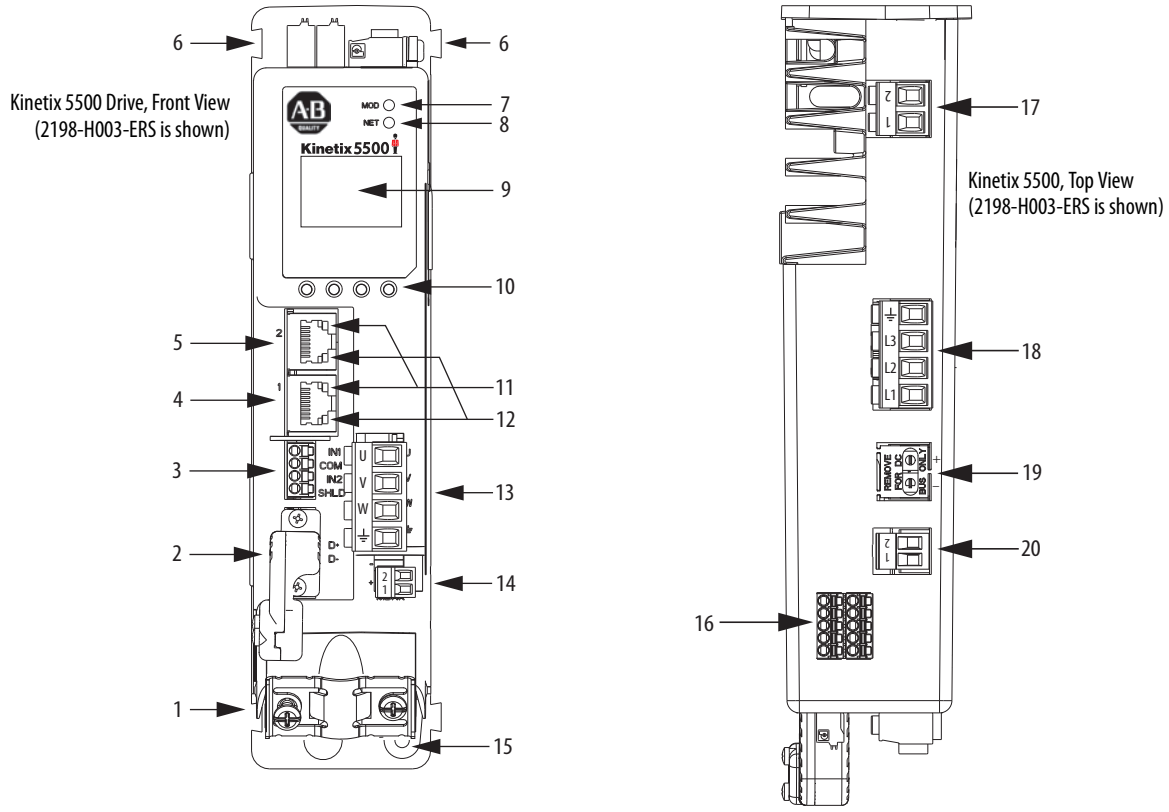
This chapter illustrates drive connectors and indicators, including connector pinouts, and provides descriptions for Kinetix 5500 drive features.

Topic	Page
Kinetix 5500 Connector Data	52
Understanding Control Signal Specifications	56
Power and Relay Specifications	58
Feedback Specifications	59
Safe Torque-off Safety Features	59

Kinetix 5500 Connector Data

Use these illustrations to identify the connectors and indicators for the Kinetix 5500 servo drives.

Figure 25 - Kinetix 5500 Drive Features and Indicators



Item	Description
1	Motor cable clamp
2	Motor feedback (MF) connector
3	Digital inputs (IOD) connector
4	Ethernet (PORT1) RJ45 connector
5	Ethernet (PORT2) RJ45 connector
6	Zero-stack mounting tab/cutout
7	Module status indicator
8	Network status indicator
9	LCD display
10	Navigation pushbuttons

Item	Description
11	Link speed status indicators
12	Link/Activity status indicators
13	Motor power (MP) connector
14	Motor brake (BC) connector
15	Ground terminal
16	Safe torque-off (STO) connector
17	Shunt resistor (RC) connector
18	AC mains input power (IPD) connector
19	DC bus (DC) connector (under cover) (1)
20	24V control input power (CP) connector

(1) DC bus connector ships with protective knock-out cover, which can be removed for use in shared-bus configurations.

Safe Torque-off Connector Pinout

For the safe torque-off (STO) connector pinouts, feature descriptions, and wiring information, refer to Chapter 9 beginning on page 131.

Input Power Connector Pinouts

Table 16 - Mains Input Power Connector

IPD Pin	Description	Signal
⏚	Chassis ground	⏚
L3	Three-phase input power	L3
L2		L2
L1		L1

Table 17 - 24V Input Power Connector

CP Pin	Description	Signal
1	24V power supply, customer supplied	24V+
2	24V common	24V-

DC Bus and Shunt Resistor Connector Pinouts

Table 18 - DC Bus Power Connector

DC Pin	Description	Signal
1	DC bus connections	DC-
2		DC+

Table 19 - Shunt Resistor Connector

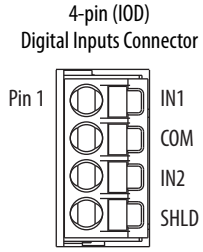
RC Pin	Description	Signal
1	Shunt connections (frames 2 and 3)	DC+
2		SH
1	Shunt connections (frame 1)	SH
2		DC+

Digital Inputs Connector Pinout

IOD Pin	Description	Signal
1	High speed registration/home position input. A low/high or high/low transition triggers a registration event. This is a dual-function input.	IN1 (1)
2	I/O common for customer-supplied 24V supply.	COM
3	High speed registration input. A low/high or high/low transition triggers a registration event.	IN2
4	I/O cable shield termination point.	SHLD

(1) This signal has dual-functionality. You can use IN1 (IOD-1) as registration or Home input.

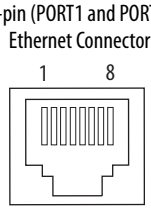
Figure 26 - Pin Orientation for 4-pin Digital Inputs (IOD) Connector



Ethernet Communication Connector Pinout

Pin	Description	Signal
1	Transmit+	TD+
2	Transmit-	TD-
3	Receive+	RD+
4	Reserved	–
5	Reserved	–
6	Receive-	RD-
7	Reserved	–
8	Reserved	–

Figure 27 - Pin Orientation for 8-pin Ethernet PORT1 and PORT2 Connectors



Motor Power, Brake, and Feedback Connector Pinouts

Table 20 - Motor Power Connector

MP Pin	Description	Signal	Color
U	Three-phase motor power	U	Brown
V		V	Black
W		W	Blue
⏚	Chassis ground	⏚	Green

IMPORTANT Drive-to-motor power cables must not exceed 50 m (164 ft).

System performance was tested at this cable length. These limitations also apply when meeting CE requirements.

Table 21 - Motor Brake Connector

BC Pin	Description	Signal
1	Motor brake connections	MBRK+
2		MBRK-

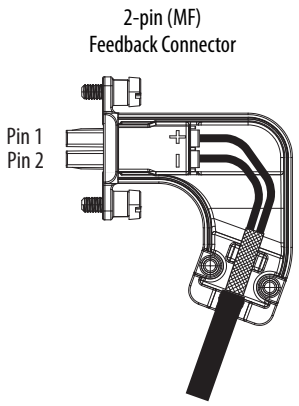
Motor Feedback Connector Pinout

MF Pin	Description	Signal
1	Bidirectional data and power for digital encoder interface	D+
2		D-
SHIELD	Cable shield and grounding plate (internal to 2198-KITCON-DSL connector kit) termination point.	SHIELD

IMPORTANT Drive-to-motor power cables must not exceed 50 m (164 ft).

System performance was tested at these cable length specifications. These limitations also apply when meeting CE requirements.

Figure 28 - Pin Orientation for 2-pin Motor Feedback (MF) Connector



Understanding Control Signal Specifications

This section provides a description of the Kinetix 5500 digital inputs, Ethernet communication, power and relay specifications, induction motor control methods, encoder feedback specifications, and safe torque-off features.

Digital Inputs

Two digital inputs are available for the machine interface on the IOD connector. Digital inputs require a 24V DC @ 15 mA supply. These are sinking inputs that require a sourcing device. A common and cable shield connection is provided on the IOD connector for digital inputs.

The Registration 1 input is capable of dual functionality. You can also use this as the Home input. Configuration for dual functionality is not needed.

IMPORTANT To improve registration input EMC performance, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

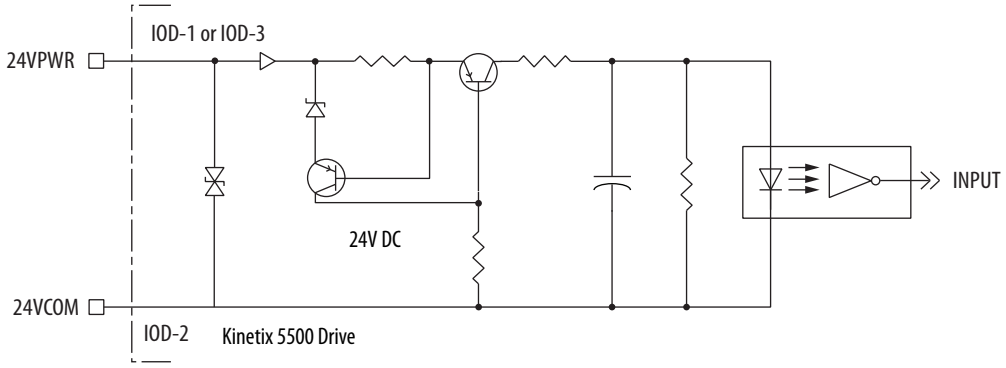
Table 22 - Understanding Digital Input Functions

Function	Description	Default Behavior
Home/Reg1	An active state indicates to a homing sequence that the referencing sensor has been seen. Typically, a transition of this signal is used to establish a reference position for the machine axis.	The function is always inactive. You can enable in the Logix Designer application.
Registration 1	An inactive-to-active transition (also known as a positive transition) or active-to-inactive transition (also known as a negative transition) is used to latch position values for use in registration moves.	
Registration 2		

Table 23 - Digital Input Specifications

Attribute	Value
Type	Active high, single-ended, current sinking (EN 61131-2 Type 1)
Dedicated functions	Registration 1, Home, Registration 2
Input current (with 24V applied)	12 mA, typical
On-state input voltage	15…30V @ 15 mA, max
Off-state input voltage	-1.0…5.0V
Pulse reject filtering (registration functions)	12.0 µs
Pulse reject filtering (home input function) debounce filter	20 ms, nom
Propagation delay (registration functions)	0 (delay compensated)
Registration repeatability	700 ns
Windowed registration invalid-to-valid event delay	125 µs, min

Figure 29 - Digital Input Circuitry



Ethernet Communication Specifications

The PORT1 and PORT2 (RJ45) Ethernet connectors are provided for communication with the Logix5000 controller.

Attribute	Value
Communication	The drive auto-negotiates speed and duplex modes. These modes may be forced through the Logix Designer application. 100BASE-TX, full duplex is recommended for maximum performance.
Cyclic update period	500 µs, min
Embedded switch features	Three-port, cut-through, time correction on IEEE-1588 packets, limited filtering, quality of service with four priority levels
Auto MDI/MDIX crossover detection/ correction	Yes
Port-to-port time synchronization variation	100 ns, max
Cabling	CAT5e shielded, 100 m (328 ft) max

Power and Relay Specifications

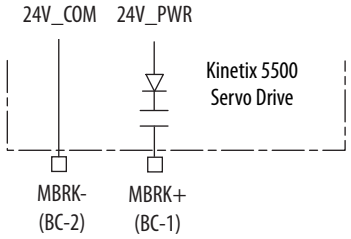
This section provides a description of the brake relay (BC), input power (IPD), motor power (MP), and control power (CP) connectors.

Motor Brake Relay

The motor brake circuit use a solid-state switch. Two connections are required for the motor brake output. Connections are rated for 2.0 A @ +24V. The 24V supply is sourced directly to the brake. No relay is required.

An active signal releases the motor brake (BC-1 and BC-2). Turn-on and turn-off delays are specified by the brake-active delay and brake-inactive delay (configurable in the Logix Designer application). Refer to Kinetix 5500 Drive/ Motor Wiring Example beginning on page 147 for wiring examples.

Figure 30 - Brake Relay Circuit



Control Power

The Kinetix 5500 drive requires 24V DC input power for control circuitry.

IMPORTANT SELV and PELV rated power supplies must be used to energize external safety devices connected to the Kinetix 5500 safety inputs.

The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these codes is the responsibility of the machine builder.

Table 24 - Control Power Input Power Specifications

Attribute	Frame 1	Frame 2	Frame 3
Input voltage	21.6…26.4V DC		
Control power AC input current Nom @ 24V DC (1) Inrush, max	 400 mA 2.0 A	 800 mA 3.0 A	 1.3 A 3.0 A

(1) Plus BC connector (MBRK+) current.

Feedback Specifications

The Kinetix 5500 drive accepts motor feedback signals from Stegmann Hiperface digital servo link (DSL) encoders.

Kinetix 5500 drive/motor combinations use single-motor-cable technology with motor power, feedback, and brake wires (when specified) housed in a single cable. Feedback and brake wires are shielded separately and each provide a shield braid for grounding in the motor cable clamp.

TIP Auto-configuration in the Logix Designer application of intelligent absolute, high-resolution, and incremental encoders is possible only with Allen-Bradley motors.

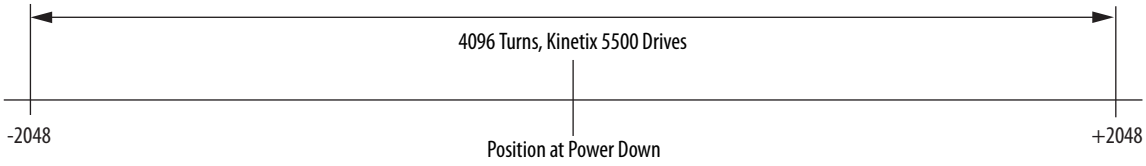
Table 25 - Stegmann Hiperface DSL Specifications

Attribute	Value
Protocol	Hiperface DSL
Memory support	Programmed with Allen-Bradley motor data
Hiperface data communication	9.375 Mbits/s

Absolute Position Feature

The drive's absolute position feature tracks the position of the motor, within the multi-turn retention limits, while the drive is powered off. The absolute position feature is available with only multi-turn (-P) encoders, for example, motor catalog number VPL-B*xxxxx*-P.

Figure 31 - Absolute Position Retention Limits



Safe Torque-off Safety Features

Kinetix 5500 drives have the capability to safely turn off the inverter power transistors in response to a monitored digital input, according to Category 0 Stop behavior. These drives support parallel input terminals for cascading to adjacent drives over duplex wiring.

For applications that do not require the safety function you must install jumper wires to bypass the safe torque-off feature. Refer to Chapter 9 on page 131 for the STO connector pinout, installation, and wiring information.

Notes:

Connecting the Kinetix 5500 Drive System

This chapter provides procedures for wiring your Kinetix 5500 system components and making cable connections.

Topic	Page
Basic Wiring Requirements	62
Determine the Input Power Configuration	63
Removing the Grounding Screws in Ungrounded Power Configurations	65
Grounding the Drive System	67
Wiring Requirements	69
Wiring Guidelines	70
Wiring the Power Connectors	71
Wiring the Digital Input and Motor Cable Connectors	72
Wiring the Digital Input and Motor Cable Connectors	72
Apply the Single Motor Cable Shield Clamp	77
Capacitor Module Connections	79
External Shunt Resistor Connections	80
Ethernet Cable Connections	81

Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 5500 drives.

ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2198 drive modules prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

IMPORTANT This section contains common PWM servo system wiring configurations, size, and practices that can be used in a majority of applications. National Electrical Code, local electrical codes, special operating temperatures, duty cycles, or system configurations take precedence over the values and methods provided.

Routing the Power and Signal Cables

Be aware that when you route power and signal wiring on a machine or system, radiated noise from nearby relays, transformers, and other electronic devices can be induced into I/O communication, or other sensitive low voltage signals. This can cause system faults and communication anomalies.

The Bulletin 2090 single motor cable contains the power, brake, and feedback wires, but is properly shielded to protect the noise-sensitive feedback signals.

Refer to Electrical Noise Reduction on page 30 for examples of routing high and low voltage cables in wireways. Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, for more information.

Determine the Input Power Configuration

Before wiring input power to your Kinetix 5500 system, you must determine the type of input power you are connecting to. The drive is designed to operate in both grounded and ungrounded environments.

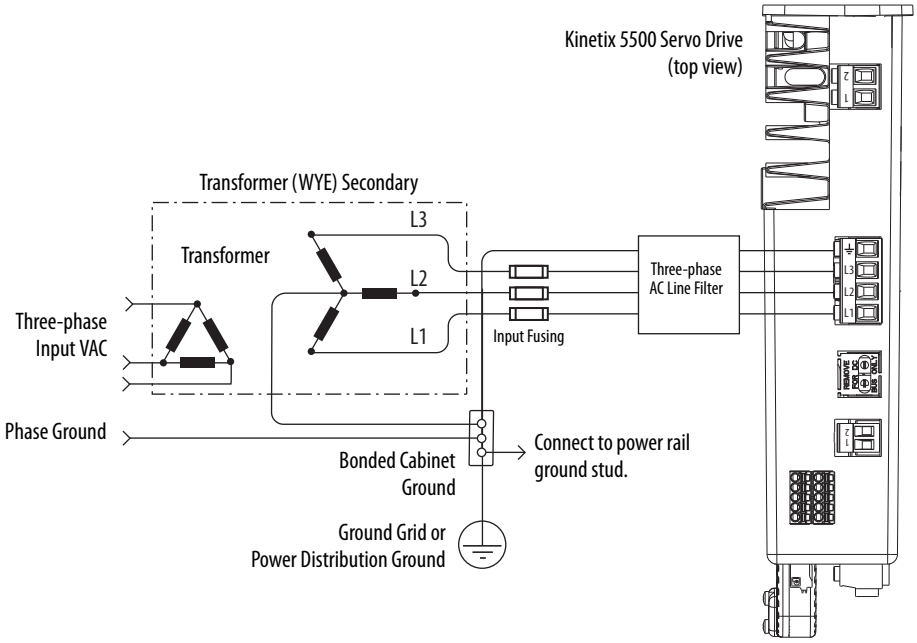
ATTENTION: Ungrounded and corner-grounded input power configurations are permitted, but you must remove the ground screws.

Refer to Removing the Grounding Screws in Ungrounded Power Configurations on page 65 for more information.

Grounded Power Configurations

The grounded (WYE) power configuration lets you ground your three-phase power at a neutral point. This type of grounded power configuration is preferred.

Figure 32 - Grounded Power Configuration (WYE Secondary)

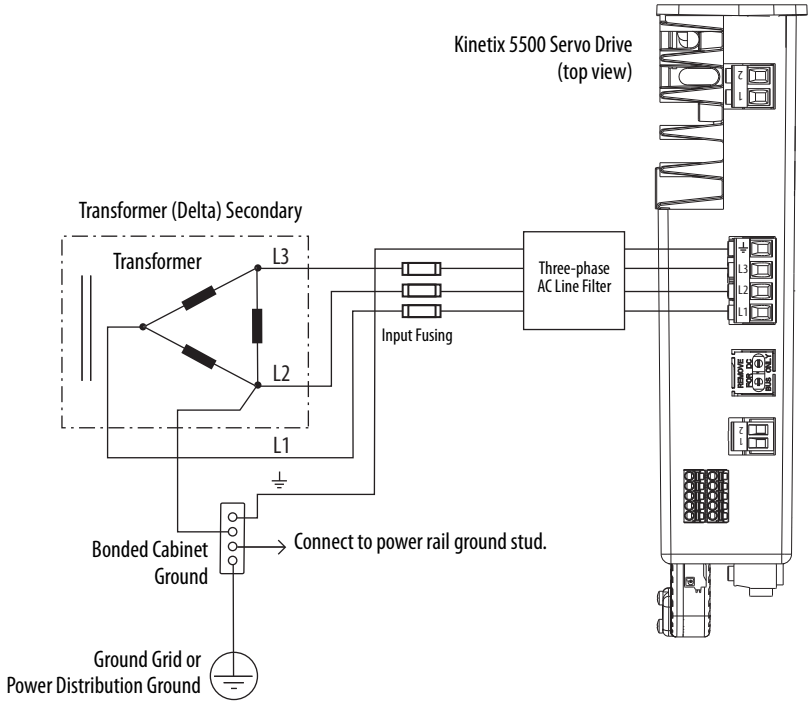


The Kinetix 5500 drive has factory-installed grounding screws for grounded power distribution.

IMPORTANT If you determine that you have grounded power distribution in your plant, you do not need to remove the grounding screws.

Refer to Power Wiring Examples beginning on page 142 for input power interconnect diagrams.

Figure 33 - Corner Grounded (B-phase) Power Configuration (Delta Secondary)



IMPORTANT	Even though corner-grounded power configurations have a ground connection, treat them as ungrounded when installing Kinetix 5500 drive systems.

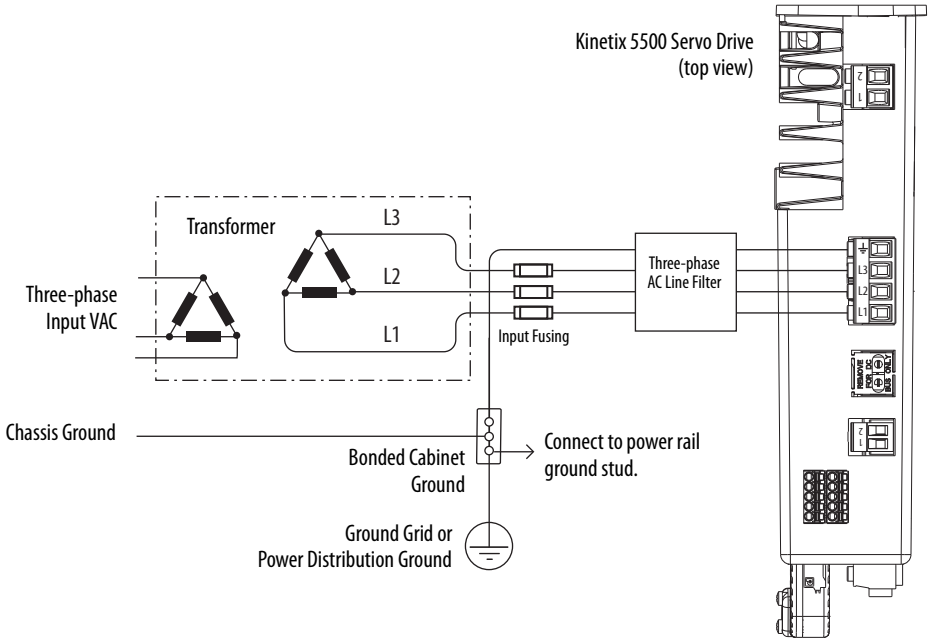
Refer to Power Wiring Examples beginning on page 142 for input power interconnect diagrams.

Ungrounded Power Configurations

The ungrounded power configuration (Figure 34) does not provide a neutral ground point.

IMPORTANT	If you determine that you have ungrounded or high-impedance grounded power distribution in your facility, you need to remove the grounding screws. Refer to Removing the Grounding Screws in Ungrounded Power Configurations on page 65 for more information.

Figure 34 - Ungrounded Power Configuration



ATTENTION: Ungrounded systems do not reference each phase potential to a power distribution ground. This can result in an unknown potential to earth ground.

Refer to Power Wiring Examples beginning on page 142 for input power interconnect diagrams.

Removing the Grounding Screws in Ungrounded Power Configurations

Removing the grounding screws is necessary only when using ungrounded or corner-ground power configurations. Removing the screws involves gaining access, opening the sliding door, and removing the screws.

IMPORTANT If you have grounded power distribution, you do not need to remove the grounding screws. Go to Grounding the Drive System on page 67.

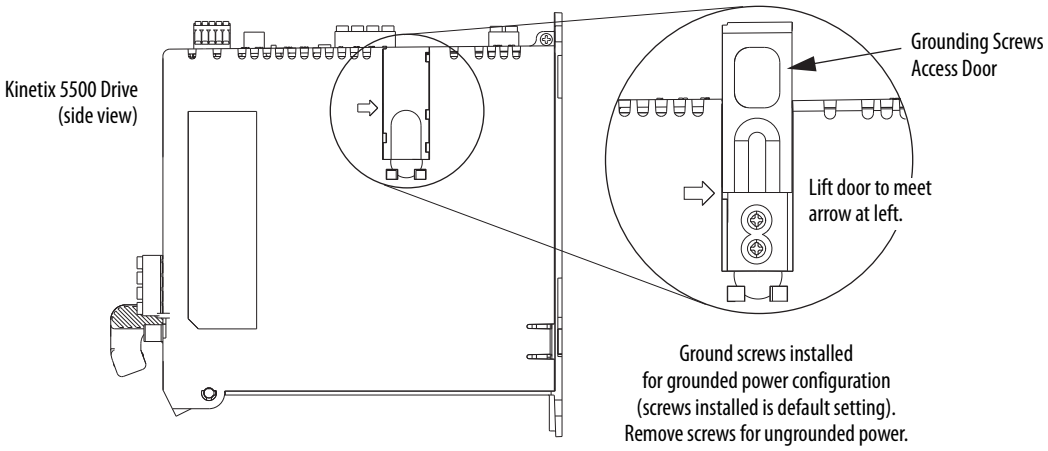
IMPORTANT Removing the grounding screws may affect EMC performance.

Removing the grounding screws in multi-axis configurations is best done when the drive is removed from the panel and placed on its side on a solid surface equipped as a grounded static-safe workstation.

ATTENTION: By removing the grounding screws for ungrounded power configurations, you no longer maintain line-to-neutral voltage protection.

ATTENTION: This drive contains electrostatic discharge (ESD) sensitive parts and assemblies. You are required to follow static-control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Guarding Against Electrostatic Damage, publication 8000-4.5.2, or any other applicable ESD awareness handbook.

Figure 35 - Removing the Ground Screws



ATTENTION: Risk of equipment damage exists. The drive ground configuration must be accurately determined. Leave the grounding screws installed for grounded power configurations (default). Remove the screws for ungrounded power.

Table 26 - Grounding Screw Configurations

Ground Configuration	Example Diagram	Grounding Screw Configuration	Benefits of Correct Configuration
Grounded (wye)	Figure 32 on page 63	Both screws installed (default setting)	• UL and EMC compliance • Reduced electrical noise • Most stable operation • Reduced voltage stress on components and motor bearings
• B-phase corner ground • AC fed ungrounded	Figure 33 on page 64 Figure 34 on page 65	Both screws removed	• Helps avoid severe equipment damage when ground faults occurs • Reduced leakage current

Grounding the Drive System

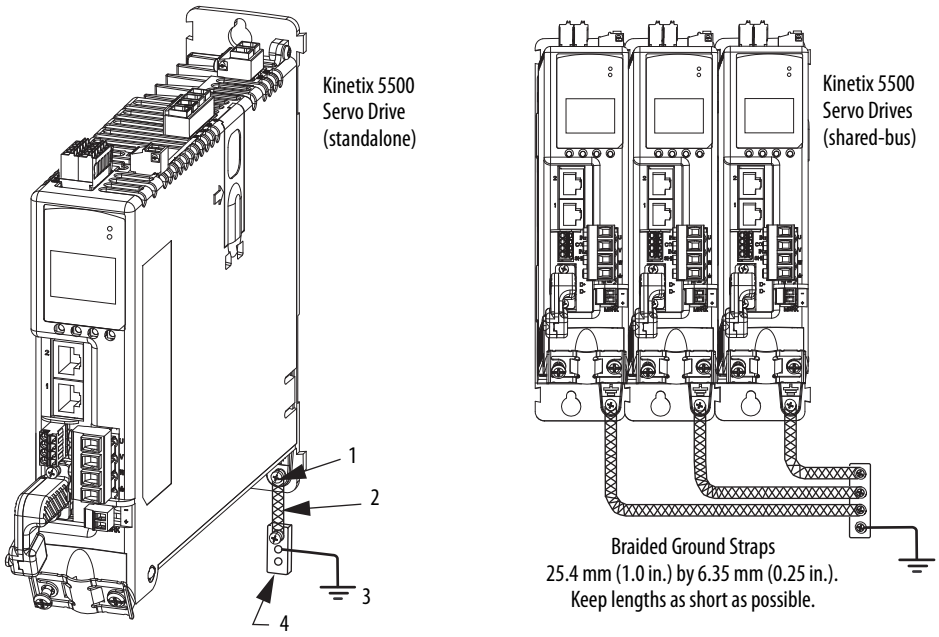
All equipment and components of a machine or process system should have a common earth ground point connected to chassis. A grounded system provides a ground path for protection against electrical shock. Grounding your drives and panels minimize the shock hazard to personnel and damage to equipment caused by short circuits, transient overvoltages, and accidental connection of energized conductors to the equipment chassis.

ATTENTION: The National Electrical Code contains grounding requirements, conventions, and definitions. Follow all applicable local codes and regulations to safely ground your system.
For CE grounding requirements, refer to Agency Compliance on page 22.

Ground the System Subpanel

Ground Kinetix 5500 drives and 2198-CAPMOD-1300 capacitor modules to a bonded cabinet ground bus with a braided ground strap or 4.0 mm2 (12 AWG) copper wire.

Figure 36 - Connecting the Ground Terminal



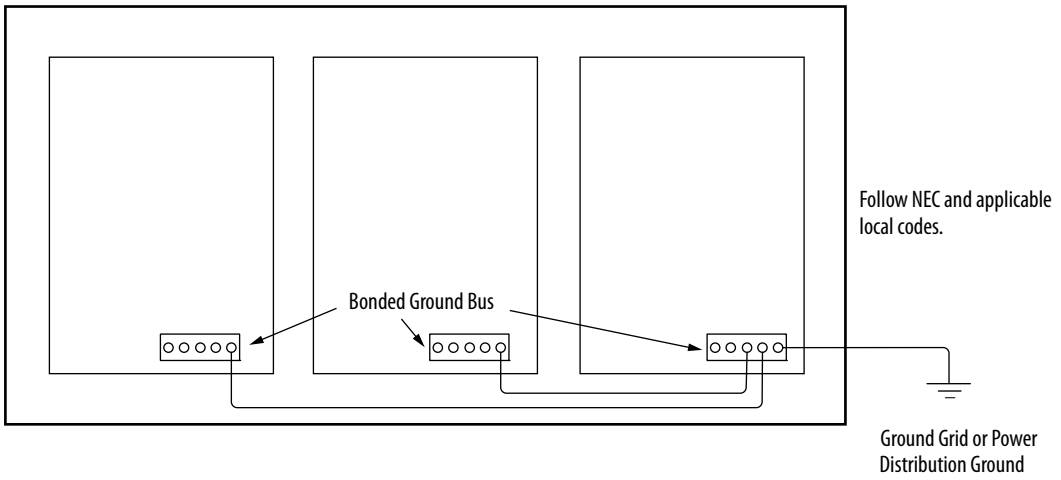
Item	Description
1	Ground screw (green) 2.0 N•m (17.5 lb-in), max
2	Braided ground strap (customer supplied)
3	Ground grid or power distribution ground
4	Bonded cabinet ground bus (customer supplied)

Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, for more information.

Ground Multiple Subpanels

In this figure, the chassis ground is extended to multiple subpanels.

Figure 37 - Subpanels Connected to a Single Ground Point



High-frequency (HF) bonding is not illustrated. For HF bonding information, refer to Bonding Multiple Subpanels on page 32.

Wiring Requirements

Wires should be copper with 75 °C (167 °F) minimum rating. Phasing of main AC power is arbitrary and earth ground connection is required for safe and proper operation.

Refer to Power Wiring Examples on page 142 for interconnect diagrams.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

Table 27 - Power and I/O Wiring Requirements

Kinetix 5500 Drive Cat. No.	Description	Connects to Terminals		Wire Size AWG	Strip Length mm (in.)	Torque Value N•m (lb•in)
		Pin	Signal			
2198-H003-ERS 2198-H008-ERS 2198-H015-ERS 2198-H025-ERS 2198-H040-ERS	Mains input power	⏚ L3 L2 L1	⏚ L3 L2 L1	1.5…4 (16…12)	8.0 (0.31)	0.5…0.6 (4.4…5.3)
2198-H070-ERS				1.5…6 (16…10)		
2198-H003-ERS 2198-H008-ERS 2198-H015-ERS 2198-H025-ERS 2198-H040-ERS	Motor power	U V W ⏚	U V W ⏚	Motor power cable depends on motor/drive combination. 0.75…2.5 (1) (18…14)	8.0 (0.31)	0.5…0.6 (4.4…5.3)
2198-H070-ERS				2.5…6 (1) (14…10)		
2198-*xxxx*-ERS	PELV/SELV 24V power	CP-1 CP-2	24V+ 24V-	2.5…0.5 (14…20)	7.0 (0.28)	0.22…0.25 (1.9…2.2)
	Brake power	BC-1 BC-2	MBRK+ MBRK-	N/A	8.0 (0.31)	
	DC Bus power	DC-1 DC-2	DC- DC+	N/A (2)	N/A (2)	N/A (2)
	Shunt resistor (frame 2 and 3)	RC-1 RC-2	DC+ SH	4…0.5 (12…20)	8.0 (0.31)	0.5…0.6 (4.4…5.3)
	Shunt resistor (frame 1)	RC-1 RC-2	SH DC+			
	Safety	ST0-1 ST0-2 ST0-3 ST0-4 ST0-5	SB+ SB- S1 SC S2	1.5…0.2 (16…24)	10.0 (0.39)	N/A
	Digital inputs	IOD-1 IOD-2 IOD-3 IOD-4	IN1 (3) COM IN2 SHLD	1.5…0.2 (16…24)	10.0 (0.39)	N/A

(1) Making your own motor cables is not an option. Use single motor cable catalog number 2090-CSxM1DF-*xx*AA*xx*. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004, for cable specifications.

(2) DC bus connections are always made from drive-to-drive over the bus bar connection system. These terminals do not receive discrete wires.

(3) This signal has dual-functionality. You can use IN1 (IOD-1) as registration or Home input.

ATTENTION: To avoid personal injury and/or equipment damage, observe the following:

- Make sure installation complies with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. The National Electrical Code (NEC) and local codes outline provisions for safely installing electrical equipment.
- Use motor power connectors for connection purposes only. Do not use them to turn the unit on and off.
- Ground shielded power cables to prevent potentially high voltages on the shield.

Wiring Guidelines

Use these guidelines as a reference when wiring the power connectors on your Kinetix 5500 drive.

IMPORTANT For connector locations of the Kinetix 5500 drives, refer to Kinetix 5500 Connector Data on page 52.

When removing insulation from wires and tightening screws to secure the wires, refer to the table on page 69 for strip lengths and torque values.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in Establishing Noise Zones on page 33.

Follow these steps when wiring the connectors for your Kinetix 5500 drive.

1. Prepare the wires for attachment to each connector plug by removing insulation equal to the recommended strip length.

   IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the cable/wires to your Kinetix 5500 drive.
3. Insert wires into connector plugs.

   Refer to connector pinout tables in Chapter 4 or the interconnect diagrams in Appendix A.
4. Tighten the connector screws.
5. Gently pull on each wire to make sure it does not come out of its terminal; reinsert and tighten any loose wires.
6. Insert the connector plug into the drive connector.

Wiring the Power Connectors

This section provides examples and guidelines to assist you in making connections to the input power and DC bus connectors.

Wire the 24V Control Power Input Connector

The 24V power (CP) connector requires 24V DC input for the control circuitry.

Figure 38 - CP Connector Wiring

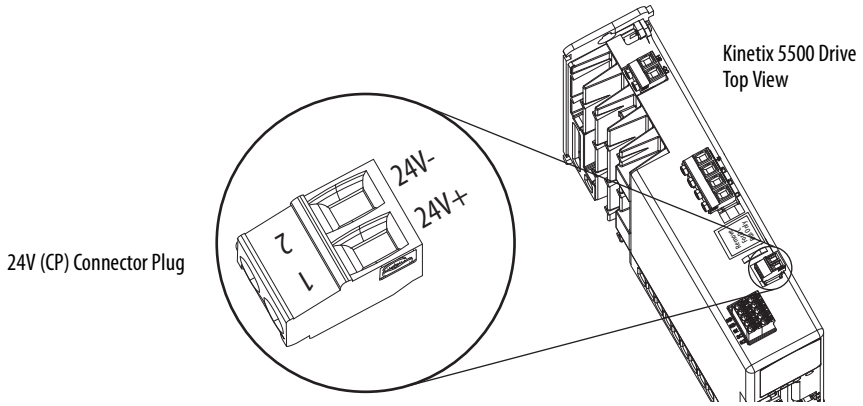


Table 28 - 24V Power (CP) Connector Specifications

Drive Cat. No.	CP Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value N•m (lb•in)
2198-H*xxxx*-ERS	CP-1	24V+	2.5…0.5 (14…20)	7.0 (0.28)	0.22…0.25 (1.9…2.2)
	CP-2	24V-			

Wire the Input Power Connector

The input power (IPD) connector requires 195...528V AC (single-phase or three-phase) for mains input power.

ATTENTION: Make sure the input power connections are correct when wiring the IPD connector plug and that the plug is fully engaged in the drive connector. Incorrect wiring/polarity or loose wiring can cause explosion or damage to equipment.

Figure 39 - IPD Connector Wiring

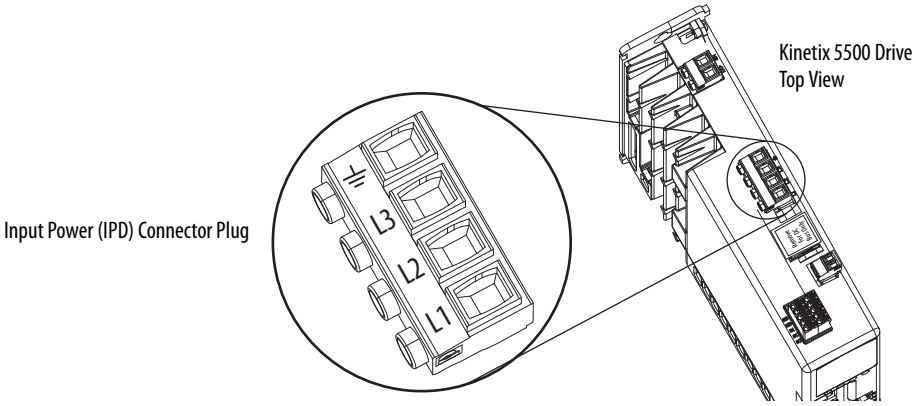


Table 29 - Input Power (IPD) Connector Specifications

Kinetix 5500 Drive Cat. No.	Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value N•m (lb•in)
2198-H003-ERS 2198-H008-ERS 2198-H015-ERS 2198-H025-ERS 2198-H040-ERS	⏚ L3 L2 L1	⏚ L3 L2 L1	1.5…4 (16…12)	8.0 (0.31)	0.5…0.6 (4.4…5.3)
2198-H070-ERS			1.5…6 (16…10)		

Wiring the Digital Input and Motor Cable Connectors

This section provides guidelines to assist you in making digital input connections and motor power, brake, and feedback connections.

Wire the Safe Torque-off Connector

For the safe torque-off (STO) connector pinouts, feature descriptions, and wiring information, refer to Chapter 9 beginning on page 131.

Wire the Digital Inputs Connector

The digital inputs (IOD) connector uses spring tension to hold wires in place.

Figure 40 - IOD Connector Wiring

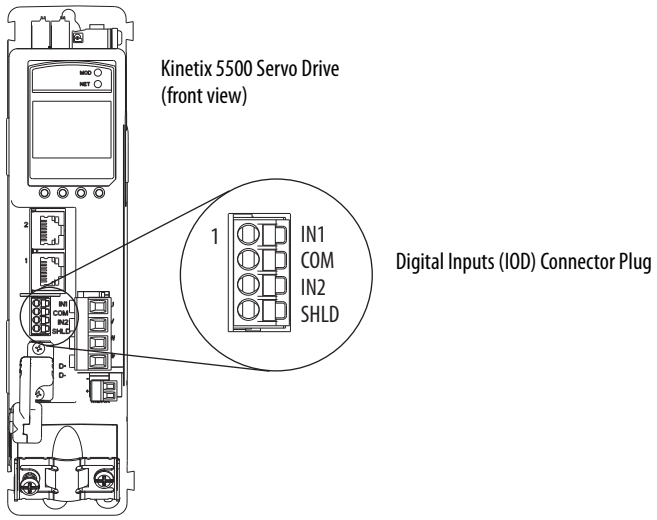


Table 30 - Digital Inputs (IOD) Connector Specifications

Drive Cat. No.	DC Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value N•m (lb•in)
2198-H*xxxx*-ERS	IOD-1 IOD-2 IOD-3 IOD-4	IN1 (1) COM IN2 SHLD	1.5…0.2 (16…24)	10.0 (0.39)	N/A

(1) This signal has dual-functionality. You can use IN1 (IOD-1) as registration or Home input.

Wire the Motor Power, Brake, and Feedback Connectors

The Kinetix 5500 drives use a single cable that includes conductors for motor power, brake, and encoder feedback. Bulletin 2090 cables are available with and without the motor brake conductors.

Refer to the Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004, for cable specifications.

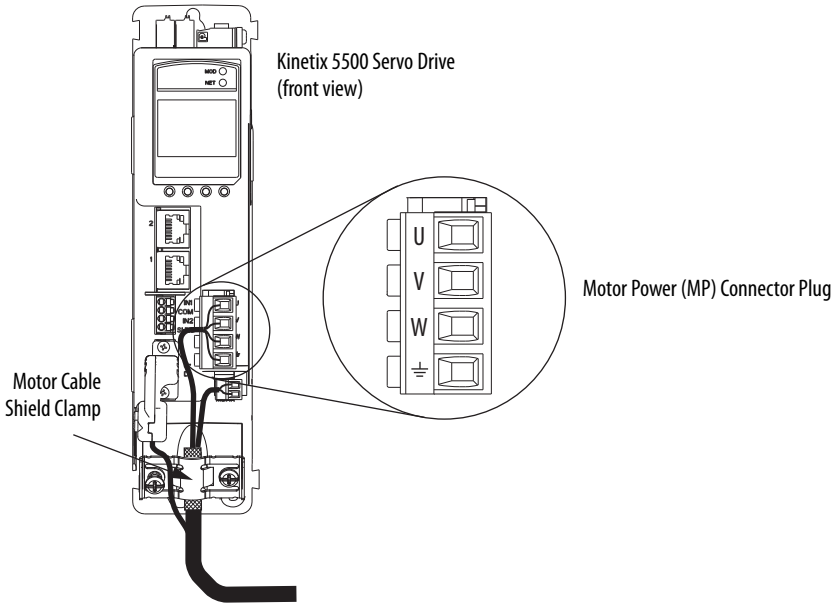
Table 31 - Single Cable Catalog Numbers

Motor/Actuator	Connector Type	Motor Cat. No.	Motor Cable Cat. No. (with brake wires)	Motor Cable Cat. No. (without brake wires)
Kinetix VP (Bulletin VPL)	Circular DIN (SpeedTec)	VPL-A/B*xxxxx*	2090-CSBM1DF-*xx*AA*xx* (standard) cable	2090-CSWM1DF-*xx*AA*xx* (standard) cable

Refer to Kinetix 5500 Drive/Motor Wiring Example on page 147 for an interconnect diagram.

Motor Power Connections

Figure 41 - MP Connector Wiring



ATTENTION: Make sure the motor power connections are correct when wiring the MP connector plug and that the plug is fully engaged in the module connector. Incorrect wiring/polarity or loose wiring can cause an explosion or damage to equipment.

Table 32 - Motor Power (MP) Connector Specifications

Drive Cat. No.	Pin	Signal/Wire Color	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value N•m (lb•in)
2198-H003-ERS 2198-H008-ERS 2198-H015-ERS 2198-H025-ERS 2198-H040-ERS	U V W ⏚	U Brown V Black W Blue ⏚ Green/Yellow	Motor power cable depends on motor/drive combination. 0.75…2.5 (18…14) max	8.0 (0.31)	0.5…0.6 (4.4…5.3)
2198-H070-ERS			2.5…6 (14…10) max		

Motor Brake Connections

Figure 42 - BC Connector Wiring

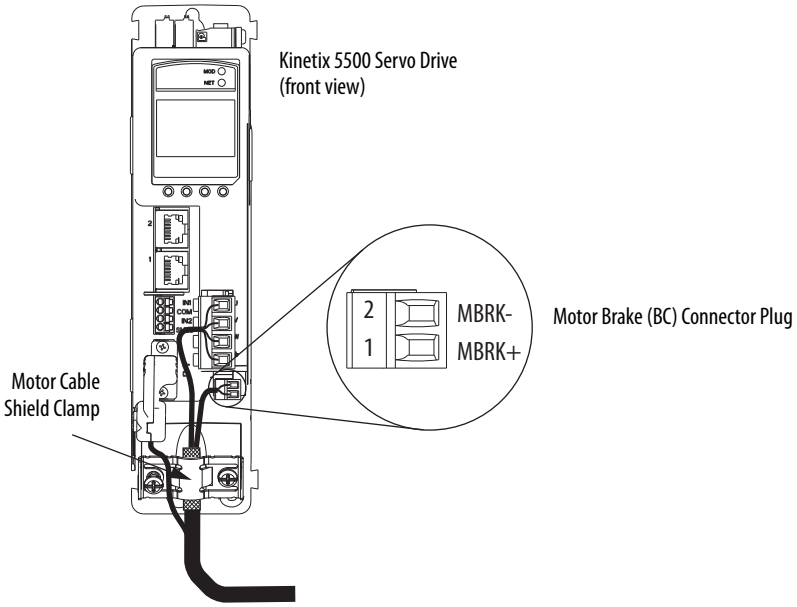


Table 33 - Motor Brake (BC) Connector Specifications

Drive Cat. No.	**Pin**	**Signal/ Wire Color**	**Recommended Wire Size** (AWG)	**Strip Length** mm (in.)	**Torque Value** N•m (lb•in)
2198-H*xxx*-ERS	BC-1	MBRK+/Black	N/A (1)	8.0 (0.31)	0.22…0.25 (1.9…2.2)
	BC-2	MBRK-/White			

(1) Motor brake wires are part of the 2090-CSBM1DF-*xx*AA*xx* motor cable.

Motor Feedback Connections

Feedback connections are made by using the 2090-KITCON-DSL feedback connector kit.

Figure 43 - MF Connector Wiring

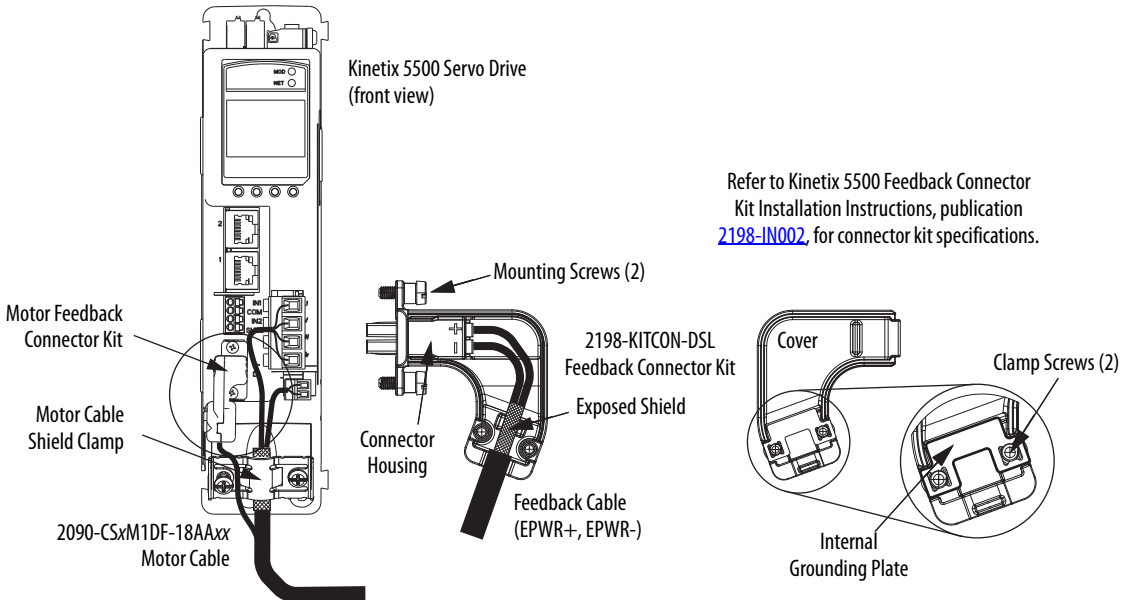


Table 34 - Motor Feedback (MF) Connector Specifications

Drive Cat. No.	Pin	Signal/ Wire Color	Wire Size AWG	Strip Length mm (in.)	Torque Value N•m (lb•in)
2198-H*xxx*-ERS	MF-1	D+/Blue	22	8.0 (0.31)	0.4 (3.5)
	MF-2	D-/White			

IMPORTANT The feedback bundle in 2090-CS*x*M1DF-18AA*xx* motor cables (typically used with frame 1 drives) route around the shield clamp (as shown in Figure 43). The feedback bundle in 14 and 10 AWG cables (typically used with frame 2 and 3 drives) route with the power and brake wires inside the cable shield.

Apply the Single Motor Cable Shield Clamp

Factory-supplied 2090-Series single motor cables are shielded, and the braided cable shield must terminate at the drive during installation. A small portion of the cable jacket has been removed to expose the shield braid. The exposed area must be clamped (with the clamp provided) at the bottom front of the drive.

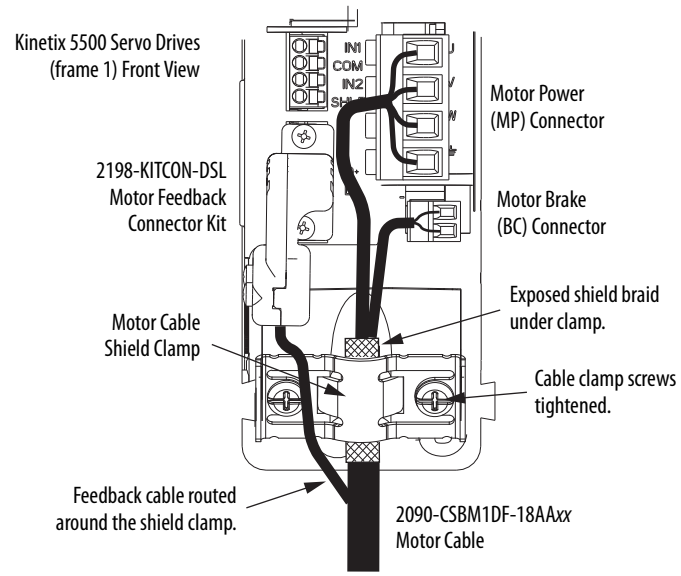
SHOCK HAZARD: To avoid hazard of electrical shock, make sure shielded power cables are grounded according to recommendations.

TIP Cables for Bulletin VPL motors (catalog numbers 2090-CB*x*M1DF-18AA*xx*) do not route the feedback bundle under the shield clamp. The same cables with 14 or 10 AWG conductors have the feedback bundle within the cable shield braid.

This procedure assumes you have completed wiring your motor power, brake, and feedback connectors and are ready to apply the cable shield clamp.

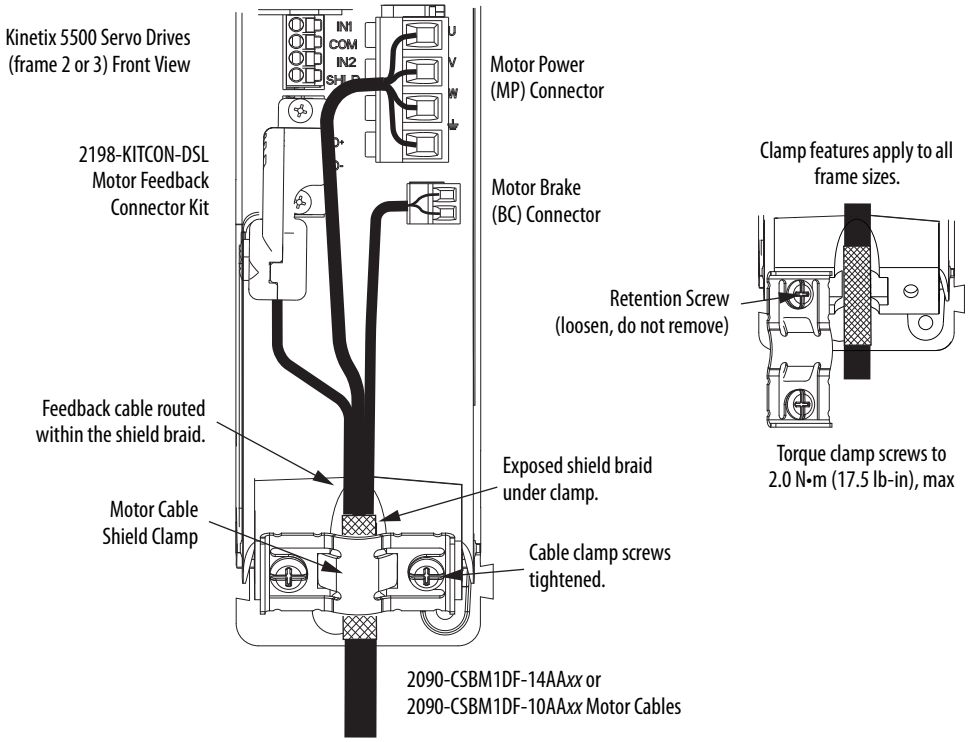
Follow these steps to apply the motor cable shield clamp.

1. Loosen the clamp screws and remove at least one of the screws..



When the drive/motor combination calls for 18 AWG cable, the feedback cable routes around the motor cable shield clamp.

Figure 44 - 14 and 10 AWG Cable Installation



When the drive/motor combination calls for 14 or 10 AWG cable, the feedback cable routes along with the power and brake wiring.

2. Position the exposed portion of the cable braid directly in line with the clamp.
3. Tighten the clamp screws. Torque value 2.0 N•m (17.7 lb•in) max.
4. Repeat step 1 through step 3 for each drive in multi-axis configurations.

Capacitor Module Connections

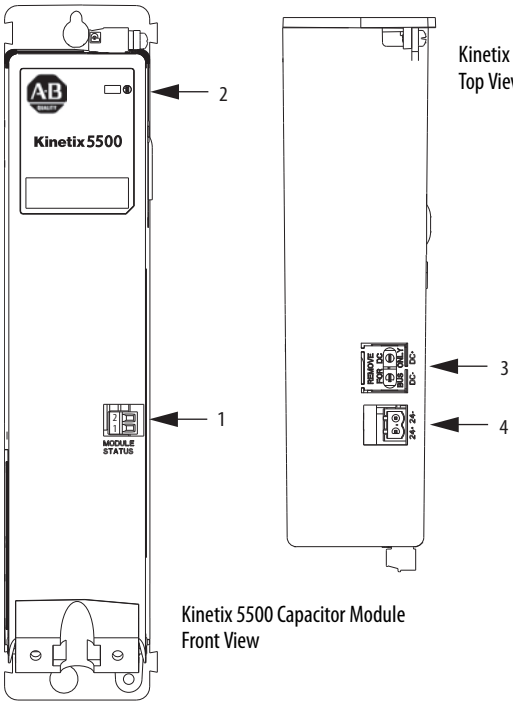
Follow these guidelines when wiring the 2198-CAPMOD-1300 capacitor module:

- Wire relay output (MS) connections to the Logix5000 controller (optional).
- Refer to Kinetix 5500 Capacitor Module wiring example on page 143.
- Refer to Kinetix 5500 Capacitor Module Status Indicators on page 120 for troubleshooting the module status indicator and relay output.
- Refer to the installation instructions provided with your Bulletin 2198 capacitor module, publication 2198-IN004.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in Chapter 2.

Connections to the DC bus and 24V control power must be made with the shared-bus connection system.

Figure 45 - Capacitor Module Wiring



Item	Description
1	Module status (MS) connector (relay output)
2	Module status indicator
3	DC bus (DC) connector (under cover) (1) (2)
4	24V control input power (CP) connector (2)

(1) DC bus connector ships with protective knock-out cover, which can be removed for use in shared-bus configurations.
(2) Shared-bus connection from upstream drive.

Table 35 - Capacitor Module Connector Specifications

Capacitor Module Cat. No.	Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value N•m (lb•in)
2198-CAPMOD-1300	MS-1	RELAY+	0.14…1.5 (28…16)	7.0 (0.28)	0.22…0.25 (1.9…2.2)
	MS-2	RELAY-			

External Shunt Resistor Connections

Follow these guidelines when wiring your 2097-R*x* shunt resistor:

- Refer to External Shunt Resistor on page 36 for noise zone considerations.
- Refer to Shunt Resistor Wiring Example on page 146.
- Refer to the installation instructions provided with your Bulletin 2097 shunt resistor, publication 2097-IN002.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in Chapter 2.

Figure 46 - RC Connector Wiring

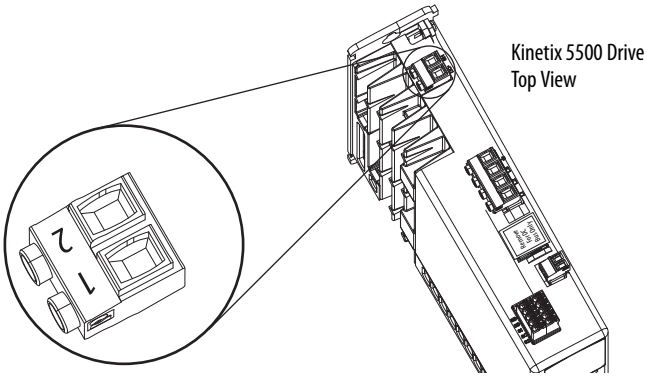


Table 36 - Shunt Resistor (RC) Connector Specifications

Drive Cat. No.	Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value N•m (lb•in)
2198-H003-ERS 2198-H008-ERS	RC-1 RC-2	SH DC+	4…0.5 (12…20)	8.0 (0.31)	0.5…0.6 (4.4…5.3)
2198-H015-ERS 2198-H025-ERS 2198-H040-ERS 2198-H070-ERS	RC-1 RC-2	DC+ SH			

IMPORTANT You must disconnect the internal shunt wires at the RC connector before connecting the Bulletin 2097 shunt resistor wires.

Table 37 - Shunt Resistor Selection

Drive Cat. No.	Bulletin 2097 Shunt Resistor Cat. No.
2198-H003-ERS	2097-R7
2198-H008-ERS	
2198-H015-ERS	
2198-H025-ERS	
2198-H040-ERS	2097-R6
2198-H070-ERS	

Ethernet Cable Connections

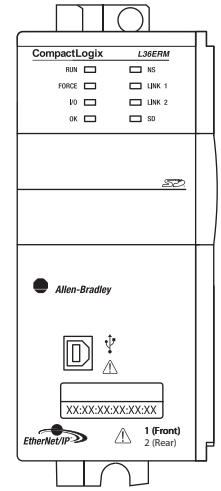
This procedure assumes you have your CompactLogix 5370 controller or ControlLogix EtherNet/IP module and Kinetix 5500 drives mounted and are ready to connect the network cables.

The EtherNet/IP network is connected by using the PORT 1 and PORT 2 connectors. Refer to page 52 to locate the Ethernet connectors on your Kinetix 5500 drive. Refer to the figure below to locate the connectors on your CompactLogix 5370 controller.

Shielded Ethernet cable is available in several standard lengths. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004, for more information.

Ethernet cable lengths connecting drive-to-drive, drive-to-controller, or drive-to-switch must not exceed 100 m (328 ft).

Figure 47 - CompactLogix Ethernet Port Location



The CompactLogix 5370 controllers accept linear, ring (DLR), and star network configurations. Refer to Typical Communication Configurations on page 18 for linear, ring, and star configuration examples.

IMPORTANT When using an external Ethernet switch for routing traffic between the controller and the drive, switches with IEEE-1588 time synchronization capabilities (boundary or transparent clock) must be used to make sure switch delays are compensated.

Notes:

Configure and Start the Kinetix 5500 Drive System

This chapter provides procedures for configuring your Kinetix 5500 drive system with a Logix5000 controller.

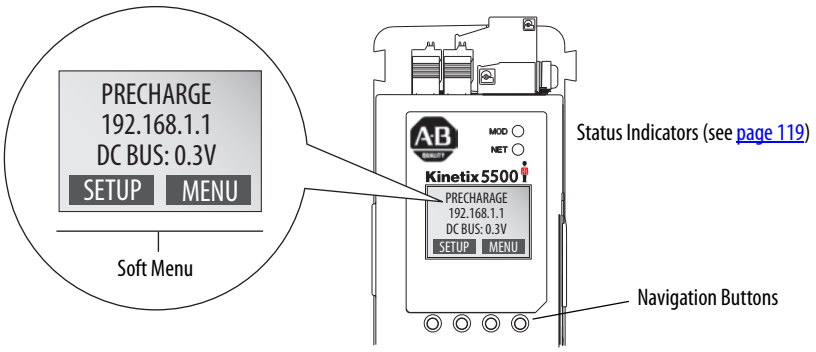
Topic	Page
Understanding the Kinetix 5500 Display	84
Configure the Drive	88
Configure the Logix5000 EtherNet/IP Controller	89
Apply Power to the Kinetix 5500 Drive	104
Test and Tune the Axes	105
Understanding Bus Sharing Group Configuration	109

TIP Before you begin, make sure you know the catalog number for each drive component, the Logix module and /or controller, and the servo motor used in your motion control application.

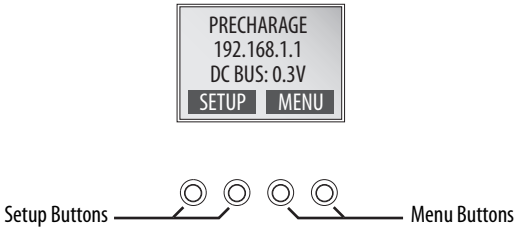
Understanding the Kinetix 5500 Display

The Kinetix 5500 drive has two status indicators and an LCD status display. The indicators and display are used to monitor the system status, set network parameters, and troubleshoot faults. Four navigation buttons are located directly below the display and are used to select items from a soft menu.

Figure 48 - Kinetix 5500 Drive LCD Display and Status Indicators

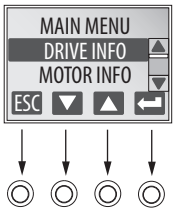


This is the Home screen. The SETUP selections are tied to the two left-side buttons and the MENU selections are tied to the two right-side buttons.



The soft menu provides a changing selection that corresponds to the current screen. Use the navigation buttons to perform the following.

Each soft menu item is executed by pressing the navigation button directly below the item, as shown in this example.



ESC	Press to go back. Pressing enough times results in the HOME screen.
▲ ▼	Pressing either arrow moves the selection to the next (or previous) item. When changing values, pressing the up arrow increments the highlighted value. Values rollover after reaching the end of the list.
◀	Press to select values to change, moving from right to left. Values rollover when reaching the end of the list.
↵	Press to select a menu item.
HOME	Press to return to the Home screen.
LOG	Press to display the list of active fault codes.
TEXT	Press to display the fault text (exception code in troubleshooting tables). (1)
INFO	Press to display the fault details (the problem in troubleshooting tables). (1)
HELP	Press to display the fault help (possible solutions in troubleshooting tables). (1)

(1) Refer to Fault Codes beginning on page 114 to review the troubleshooting tables.

Menu Screens

The menu screens provide information about the drive, motor, and fault log. There are no choices to make or settings to save. Press one of the MENU buttons to access the menu.

By using the soft menu items and navigation buttons you can view the information.

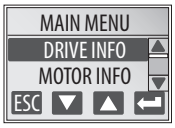


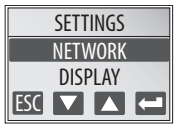
Table 38 - Navigating the Menu

Menu/Sub Menu Selections	Attributes	Description	Example Values
Drive Info	Catalog number		2198-H008-ERS
	Firmware revision		FW REV: 1.1.33
	Hardware revision		HW REV: 1.1
	Serial number		SERIAL#xxxxxxxxxx
Motor Info	Model number		MODEL: VPL-B1003C
	Serial number		SERIAL#: xxxxxxxxxx
Diagnostics> Drive Diagnostics	Bus diagnostics		BUS VOLT: 0.0V
			BUS CUR: 0.0A
	Converter diagnostics		CONV UTIL: 0.7%
			CONV TEMP: 31.7C
	Inverter diagnostics		INV UTIL: 0.0%
			INV TEMP: 31.7C
	Shunt utilization		SHUNT UTIL: 0.0%
Diagnostics> Motor Diagnostics	Motor speed		SPEED:0.0 RPM
	Motor current		MTR CUR:0.0A RMS
	Motor utilization		MTR UTIL:0.0%
	Motor temperature		MTR TEMP:0.00C
Diagnostics> Encoder Diagnostics	Serial number		SERIAL#xxxxxxxxxx
	Resolution		RESOLUTION: 262144
	Number of turns		NO OF TURNS: 1
	Encoder temperature		ENC TEMP:33.7C
	Supply voltage		SUPP VOLT:11.3V
	Link quality	The link quality attribute indicates how noisy a communication link is and also indicates if there is a communication link already established at the drive end. LINK QUAL value should always be 100%. Persistent value below 100% indicates a poor feedback ground connection.	LINK QUAL: 100.0%
	Remote signal strength indicator	Similar to Link Quality, RSSI reports the quality of link as seen at the motor end by the encoder. RSSI value should always be 100%. Persistent value below 100% indicates a poor feedback ground connection.	RSSI: 100.0%
	Accumulated position errors	This is an aggregated number of errors in the primary position feedback channel of DSL feedback.	POS ERRORS: 1
	Channel position errors	This is an aggregated number of errors on a secondary communication channel of the DSL feedback.	CHNL ERRORS: 5
Fault Log	Fault text	Fault code as listed in Fault Codes beginning on page 114.	FLT S45 - FDBK COMM FL
	Fault details	The problem as reported in Fault Codes on page 114.	The number of consecutive missed or corrupted serial data packets from the intelligent feedback device has exceeded a factory set limit
	Fault help	The Possible Solution as reported in Fault Codes on page 114.	Check motor feedback cable and connector

Setup Screens

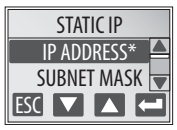
The setup screens provide the means of changing drive settings, for example, the IP address. Press one of the SETUP buttons to access the setup screens.

By using the soft menu items and navigation buttons you can view the information and make changes.



Press ↵ to validate your changes:

- If the change is invalid, the value doesn't change.
- If the change is valid, an asterisk appears next to the changed attribute.



IMPORTANT You must cycle control power to make network configuration changes persistent. In this example, the IP address was changed. The change takes affect and the asterisk disappears after control power is cycled.

Display configuration changes take effect immediately.

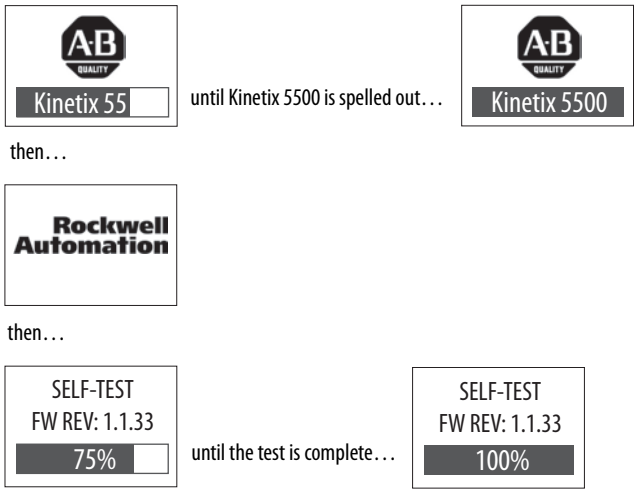
Table 39 - Navigating the Settings Menu

Settings Menu Selections	Sub Menu Selections	Attributes	Default	Description
Network	->Static IP (1)	IP address	192.168.1.1	Indicates current IP address
		Subnet mask	255.255.255.000	Indicates current subnet mask
		Gateway	192.168.001.001	Indicates current gateway
	DHCP	On		Turns DHCP on
		Off		Turns DHCP off
Display	Backlight Timeout	30 sec…NEVER (NEVER=no timeout period, the backlight is always on)	-> 3 min (1)	Sets backlight timeout period of the display
	Contrast	-10…+10	0	Contrast setting of the display
	Cyclic Data Select (2)	->DC BUS (1)		DC bus voltage
		ENC TEMP		Encoder temperature in °C
		INV UTIL		Inverter utilization in percent
		INV TEMP		Inverter temperature in °C
		CONV UTIL		Converter utilization in percent
		CONV TEMP		Converter temperature in °C
		SHUNT UTIL		Shunt utilization in percent
		MOTOR UTIL		Motor utilization in percent
		SPEED		RPM
		OUT PWR		Output power in watts
		OUT FREQ		Output frequency in hertz
		OUT CUR		Output current in amps

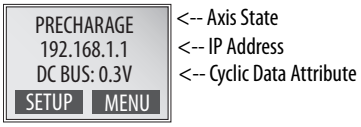
(1) An arrow (->) appears in front of the chosen attribute indicating that this attribute is currently configured. This is also the factory default setting.
(2) The DC bus voltage is one of several cyclic data attributes. You can select any of the Cyclic Data Select attributes to be displayed on the Home screen.

Startup Sequence

On initial powerup, the drive performs a self test. Upon successful completion, the drive firmware revision is displayed.



Next, the axis state, the IP address, and the default cyclic data attribute (in this example DC bus voltage) appears. In addition, the SETUP and MENU soft keys are displayed. This is the Home screen.



In this example PRECHARGE is the axis state attribute. Table 40 lists the other axis states and their descriptions.

Table 40 - Axis States on the Home Screen

Axis State	Description
STANDBY	The drive is waiting to receive configuration information from the controller.
CONNECTING	The drive is trying to establish communication with the EtherNet/IP controller.
CONFIGURING	The drive is receiving configuration information from the controller.
SYNCING	The drive is waiting for a successful Group Sync service.
STOPPED	The drive is fully configured, but the control loops are not enabled.
PRECHARGE	The drive is ready for mains input power.
RUNNING	The drive is enabled and/or running.
TESTING	The drive is actively executing a test procedure, for example, a hookup test.
STOPPING	The drive is decelerating to a stop as the result of a disable.
ABORTING	The drive is decelerating to a stop as the result of a fault or an abort request.
MAJOR FAULTED	The drive is faulted due to an existing or past fault condition.
START INHIBITED	The drive has an active condition that inhibits it from being enabled.
SHUTDOWN	The drive has been shut down.

Configure the Drive

You can include the drive in your Logix Designer application by adding it to a configured EtherNet/IP module or controller and adding it under the I/O configuration tree. After setting network parameters, you can view the drive status information in Studio 5000 software and use it in your Logix Designer application.

Set the Network Parameters

You must program network parameters by using the LCD display.

1. From the LCD display, select SETUP>NETWORK and choose between STATIC IP and DHCP.

   The default setting is STATIC IP.

2. If STATIC IP, then press ↵ to configure the following parameters:
   - IP address
   - Gateway
   - Subnet mask

Settings are stored in nonvolatile memory. IP addressing may also be changed through the Module Configuration dialog box in RSLinx® software. Changes to the IP addressing take effect after power is cycled. The drive is factory programmed to static IP address of 192.168.1.1.

Refer to Setup Screens on page 86 for help setting the network parameters.

Configure the Logix5000 EtherNet/IP Controller

These procedures assume that you have wired your Kinetix 5500 drive system. In this example, the CompactLogix 5370 controller is used.

For help using Studio 5000 software and the Logix Designer application as it applies to configuring the ControlLogix or CompactLogix controllers, refer to Additional Resources on page 10.

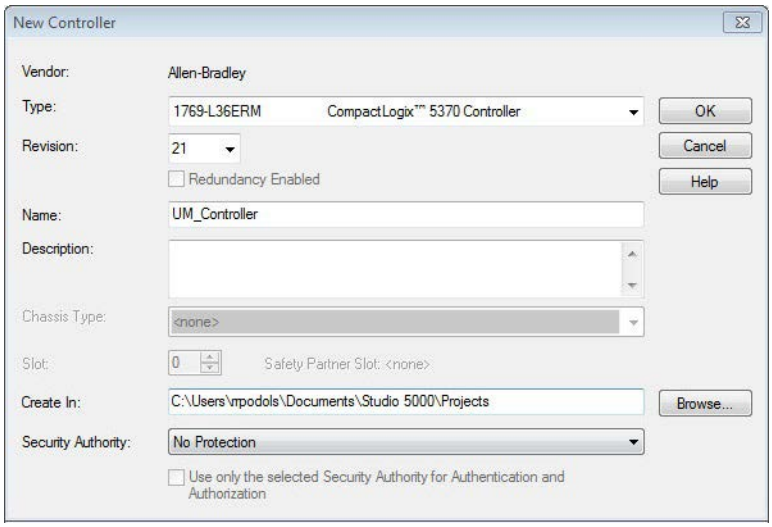
Configure the Logix5000 Controller

Follow these steps to configure the controller.

1. Apply power to your controller and open your Logix Designer application.

2. From the File menu, choose New.

   The New Controller dialog box opens.

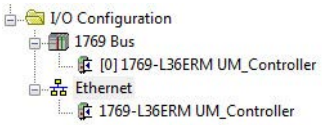


3. Configure the new controller.

   a. From the Type pull-down menu, choose the controller type.
   b. From the Revision pull-down menu, choose the revision.
   c. Type the file Name.

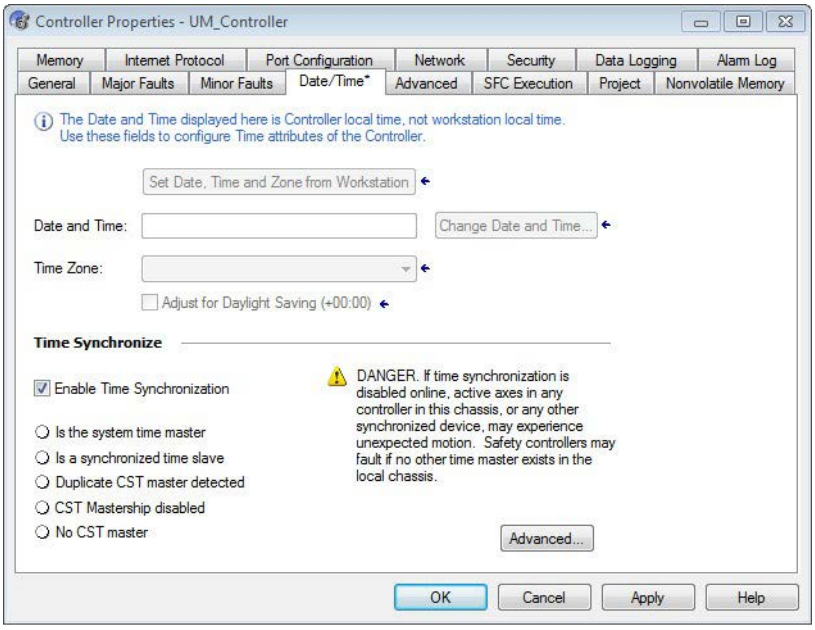
4. Click OK.

   The new controller appears in the Controller Organizer under the I/O Configuration folder.



5. From the Edit menu, choose Controller Properties.

   The Controller Properties dialog box opens.



6. Click the Date/Time tab.
7. Check Enable Time Synchronization.

   The motion modules set their clocks to the module you assign as the Grandmaster.

IMPORTANT	Check Enable Time Synchronization for all controllers that participate in CIP Sync. The overall CIP Sync network automatically promotes a Grandmaster clock, unless the priority is set in the Advanced tab.

8. Click OK.

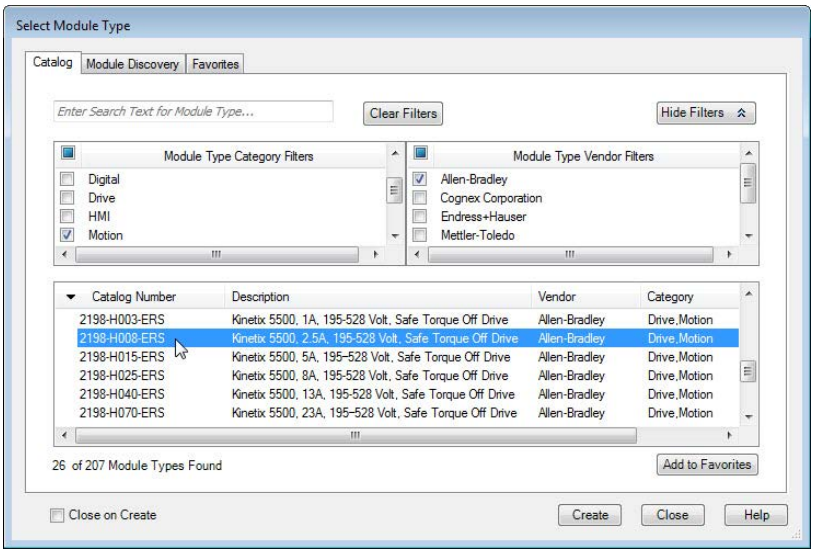
Configure the Kinetix 5500 Drive

IMPORTANT To configure Kinetix 5500 drives (catalog numbers 2198-H*xxx*-ERS) you must be using Logix Designer Application, version 21.00 or later.

Follow these steps to configure the Kinetix 5500 drive.

1. Above the controller you just created, right-click Ethernet and choose New Module.

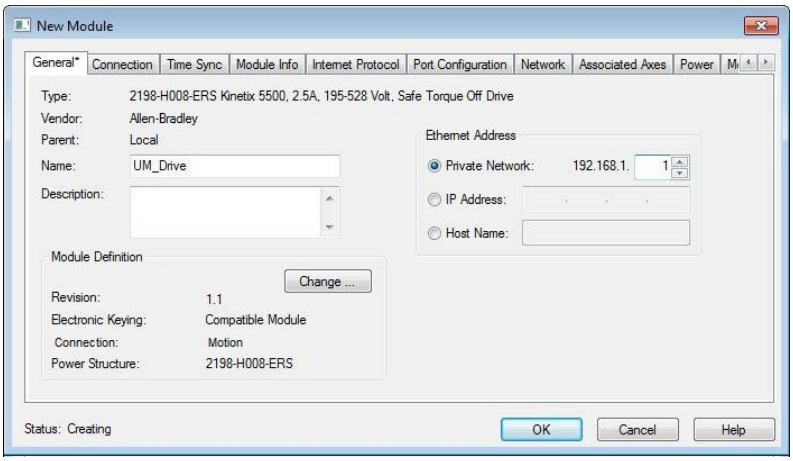
   The Select Module Type dialog box opens.



2. Using the filters, check Motion and Allen-Bradley, and select your 2198-H*xxx*-ERS servo drive as appropriate for your actual hardware configuration.

3. Click Create.

   The New Module dialog box opens.



4. Configure the new drive.

   a. Type the drive Name.

   b. Select an Ethernet Address option.

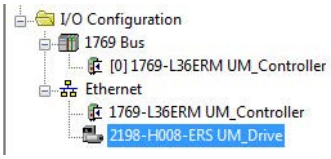
   In this example, the Private Network address is selected.

   c. Enter the address of your EtherNet/IP module.

   In this example, the last octet of the address is 1.

5. Click OK to close the New Module dialog box.

   Your 2198-H*xxx*-ERS servo drive appears in the Controller Organizer under the Ethernet controller in the I/O Configuration folder.

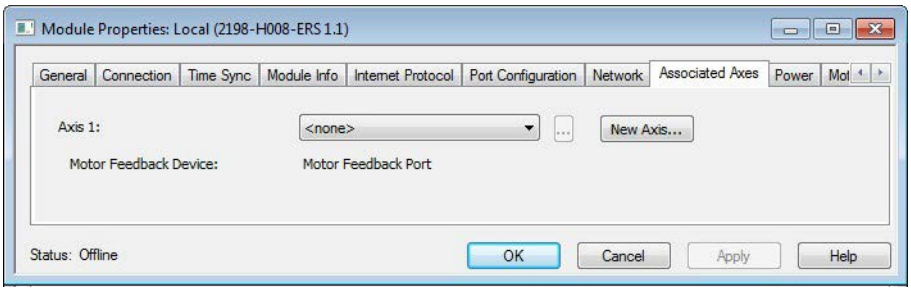


6. Click Close to close the Select Module Type dialog box.

7. Right-click the 2198-H*xxx*-ERS servo drive you just created and choose Properties.

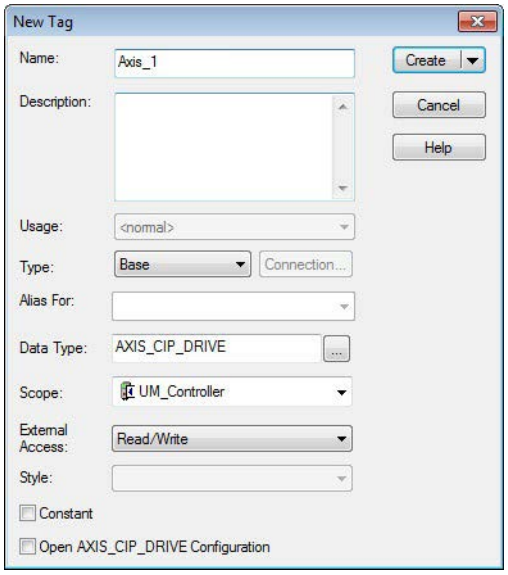
   The Module Properties dialog box opens.

8. Click the Associated Axes tab.



9. Click New Axis.

   The New Tag dialog box opens.

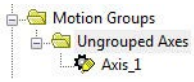


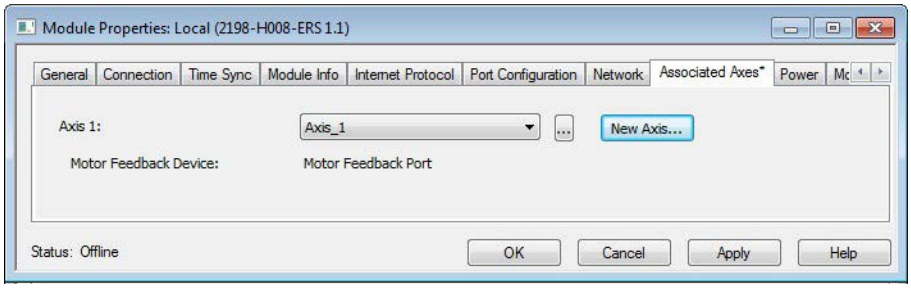
10. Type the axis Name.

    AXIS_CIP_DRIVE is the default Data Type.

11. Click Create.

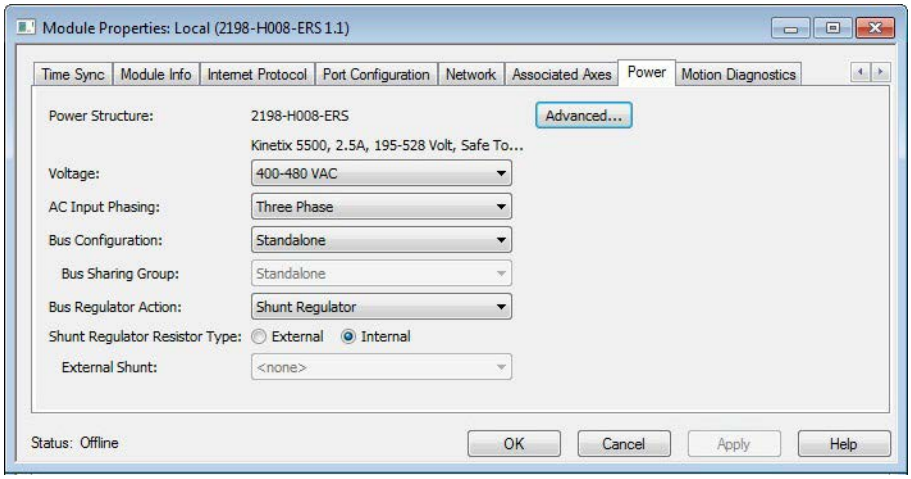
    The axis (Axis_1 in this example) appears in the Controller Organizer under Motion Groups> Ungrouped Axes and is assigned as Axis 1.





TIP You can configure an axis as Feedback Only. Refer to Configure Feedback Only Axis Properties on page 100 for more information.

12. Click Apply.
13. Click the Power tab.



IMPORTANT Single-phase operation is possible only when Module Properties>Power tab>Bus Configuration is configured as Standalone.

IMPORTANT The Logix Designer application enforces shared-bus configuration rules for Kinetix 5500 drives, except for shared AC configurations.

14. From the pull-down menus, choose the power options appropriate for your actual hardware configuration.

Attribute	Menu	Description
Voltage	• 400-480 VAC • 200-240 VAC	AC input voltage class.
AC Input Phasing	• Three Phase • Single Phase	Phase. Kinetix 5500 drives with single-phase operation is limited to 2198-H003-ERS, 2198-H008-ERS, and 2198-H015-ERS.
Bus Configuration (1) (2)	Standalone	Applies to single-axis drives and drives with Shared AC input configurations.
	Shared AC/DC	Applies to converter drives with Shared AC/DC and Shared AC/DC Hybrid input configurations.
	Shared DC	Applies to inverter drives with Shared DC input (common-bus) configurations.
Bus Sharing Group (3) (2)	Standalone	Applies to standalone bus configurations.
	• Group1 • Group2 • Group3…	Applies to any bus sharing configuration (4).
Shunt Regulator Action	Disabled	Disables the internal shunt resistor and external shunt option.
	Shunt Regulator	Enables the internal and external shunt options.
Shunt Regulator Resistor Type	Internal	Enables the internal shunt (external shunt option is disabled).
	External	Enables the external shunt (internal shunt option is disabled).
External Shunt (5)	• None • 2097-R6 • 2097-R7	Selects external shunt option. Only the shunt model intended for the drive model is shown.

(1) Refer to Chapter 3 for more information on single-axis and multi-axis configurations.
(2) Bus Configuration selection is not applicable to Kinetix 350 and Kinetix 6500 drives.
(3) For more information on bus sharing groups, refer to Understanding Bus Sharing Group Configuration on page 109.
(4) All drives physically connected to the same shared-bus connection system must be part of the same Bus Sharing Group in the Logix Designer application.
(5) Refer to the Kinetix Servo Drives Specifications Technical Data, publication GMC-TD003, for more information on the Bulletin 2097 external shunt resistors.

15. Click OK.

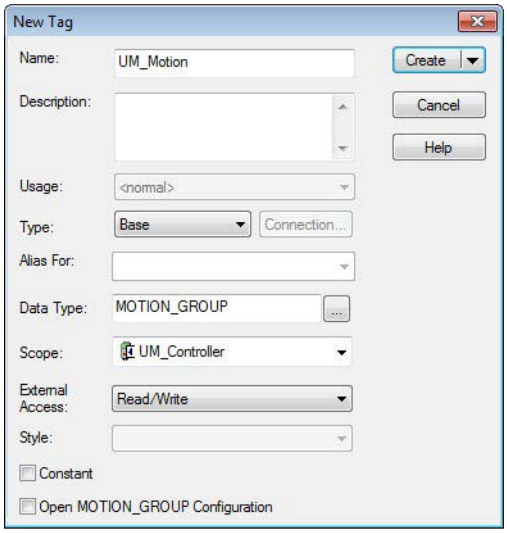
16. Repeat step 1 through step 15 for each 2198-H*xxx*-ERS servo drive.

Configure the Motion Group

Follow these steps to configure the motion group.

1. In the Controller Organizer, right-click Motion Groups and choose New Motion Group.

   The New Tag dialog box opens.

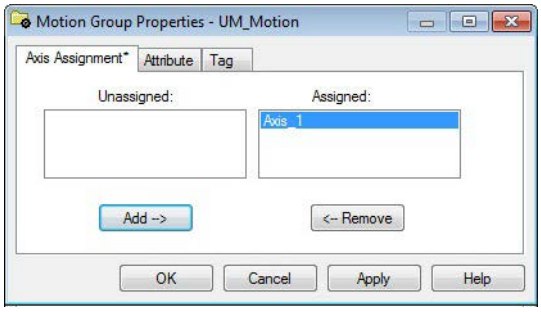


2. Type the new motion group Name.
3. Click Create.

   Your new motion group appears in the Controller Organizer under the Motion Groups folder.

4. Right-click the new motion group and choose Properties.

   The Motion Group Properties dialog box opens.



5. Click the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.
6. Click the Attribute tab and edit the default values as appropriate for your application.
7. Click OK.

   Your axis moves to the new motion group.

Configure Axis Properties

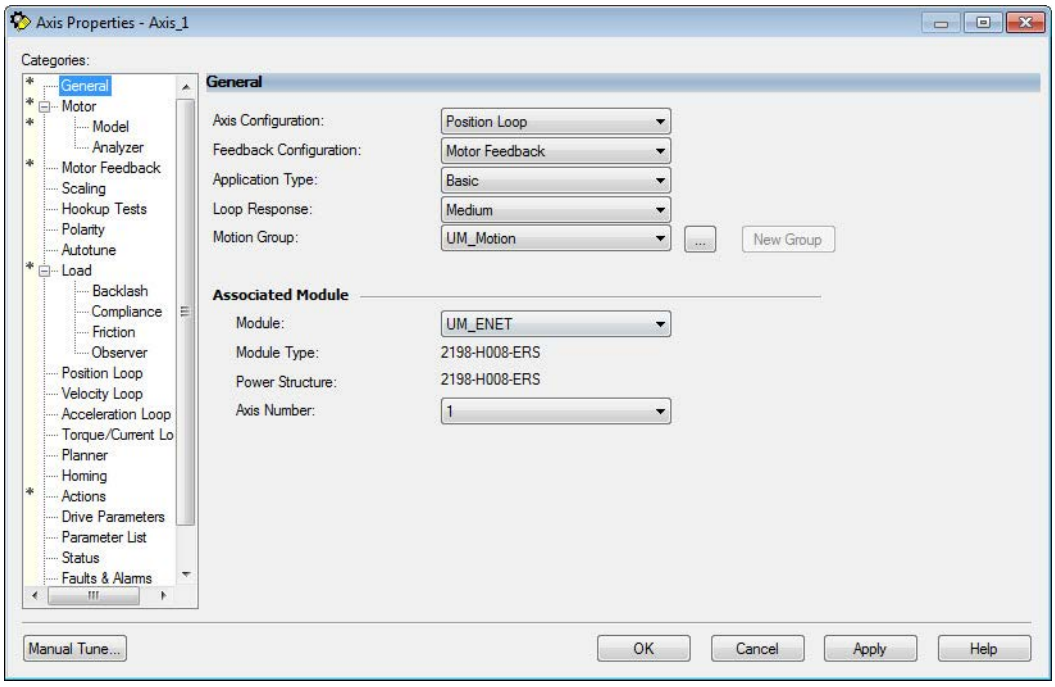
Axis configuration depends on the motor or other device (external encoder, for example) associated with each axis. This section provides guidelines for configuring servo motors, induction motors, and external encoder devices.

Configure Servo Motor Axis Properties

Follow these steps to configure servo motor axis properties.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

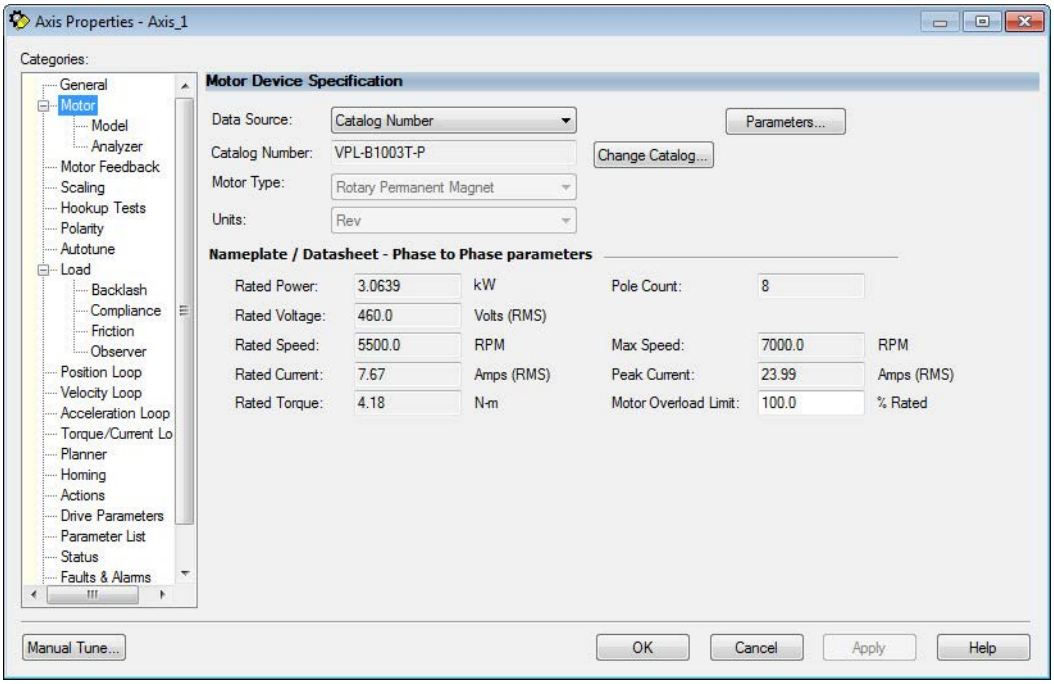
   The General and Associated Module dialog box opens.



3. From the General pull-down menus, change configuration settings as needed for your application.
4. From the Associated Module>Module pull-down menu, choose your Kinetix 5500 drive.

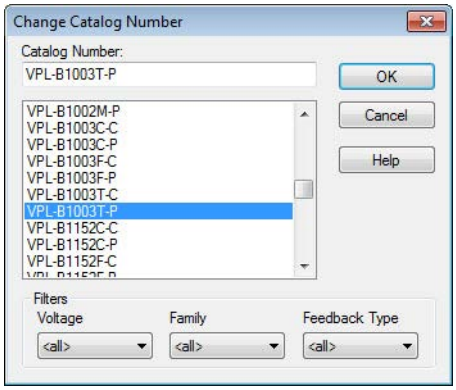
   The drive catalog number populates the Module Type and Power Structure fields.
5. Click Apply.
6. Select the Motor category.

The Motor Device Specification dialog box opens.



7. From the Data Source pull-down menu, choose Catalog Number.
8. Click Change Catalog.

   The Change Catalog Number dialog box opens.

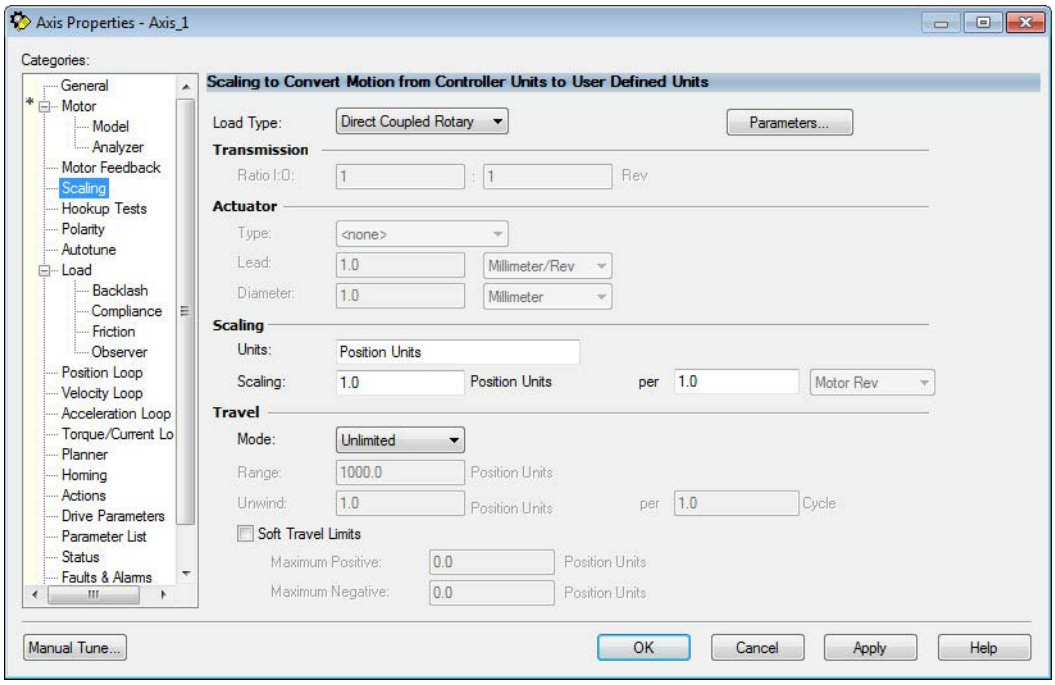


9. Select the motor catalog number appropriate for your application.

   To verify the motor catalog number, refer to the motor name plate.
10. Click OK to close the Change Catalog Number dialog box.
11. Click Apply.

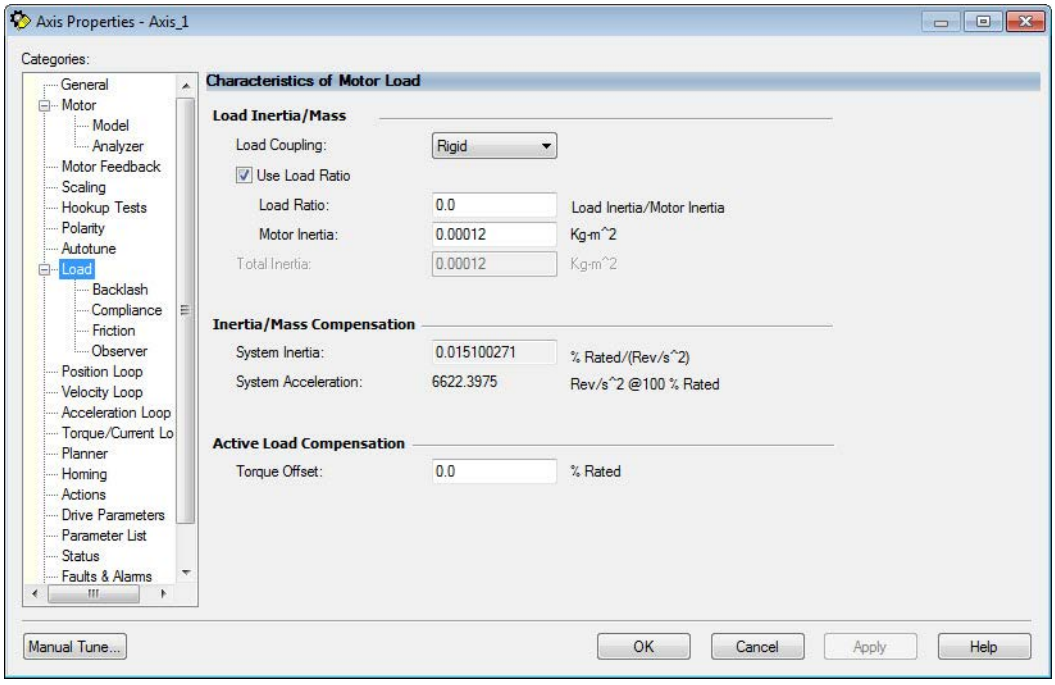
    Motor data specific to your motor appears in the Nameplate / Datasheet - Phase to Phase parameters field.

12. Select the Scaling category and edit the default values as appropriate for your application.



13. Click Apply, if you make changes.

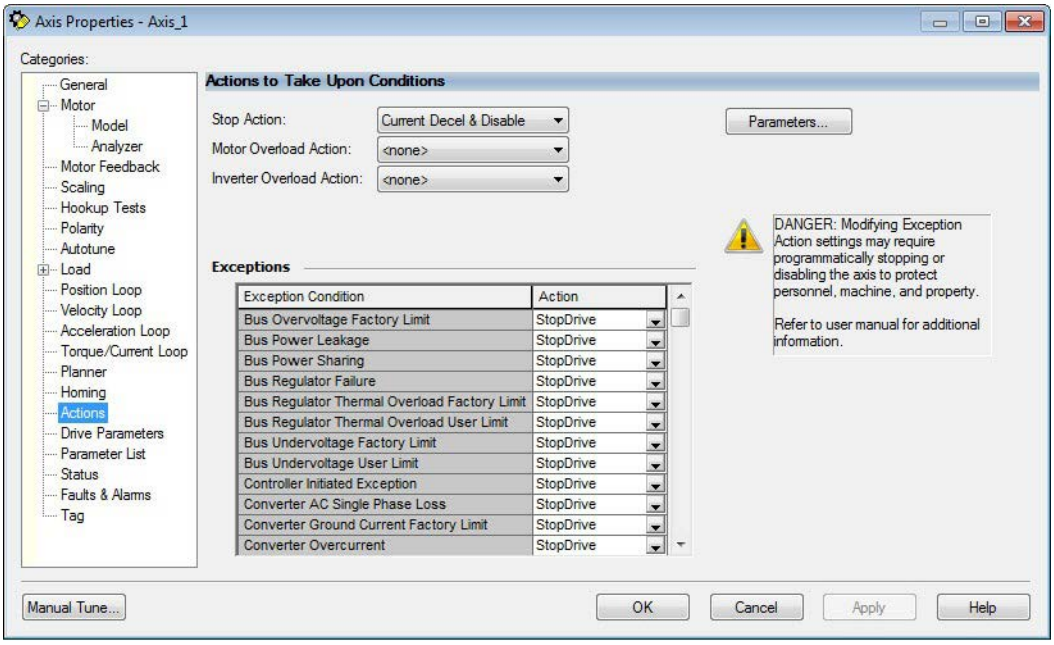
14. Select the Load category and edit the default values as appropriate for your application.



15. Click Apply, if you make changes.

16. Select the Actions category.

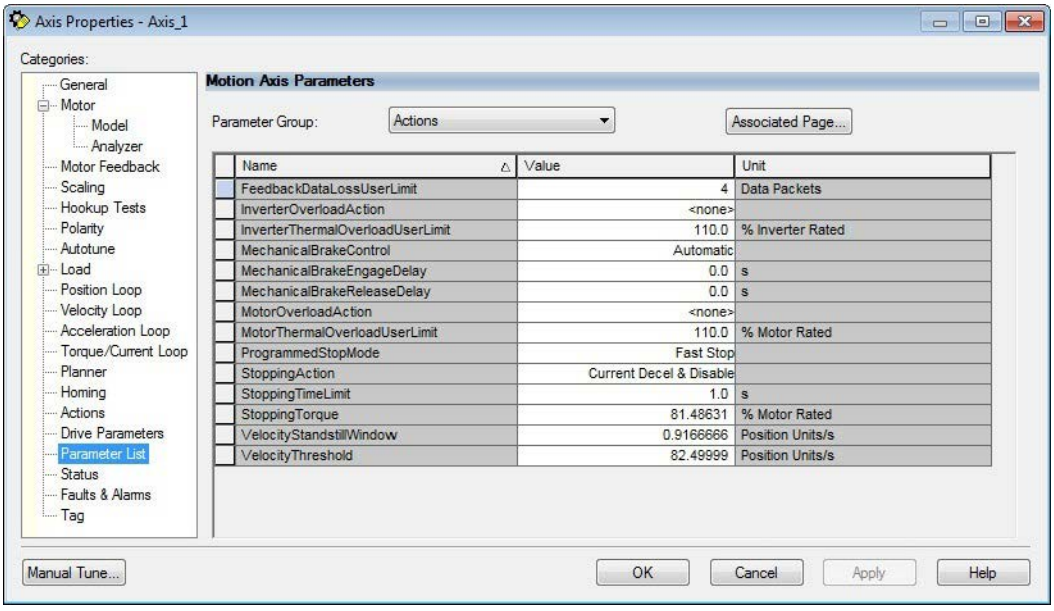
The Actions to Take Upon Conditions dialog box opens.



From this dialog box, you can program actions and change the action for exceptions (faults). Refer to Logix5000 Controller and Drive Behavior on page 122 for more information.

17. Select the Parameter List category.

    The Motion Axis Parameters dialog box opens.



From this dialog box you can set delay times for servo motors. For recommended motor brake delay times, refer to the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001.

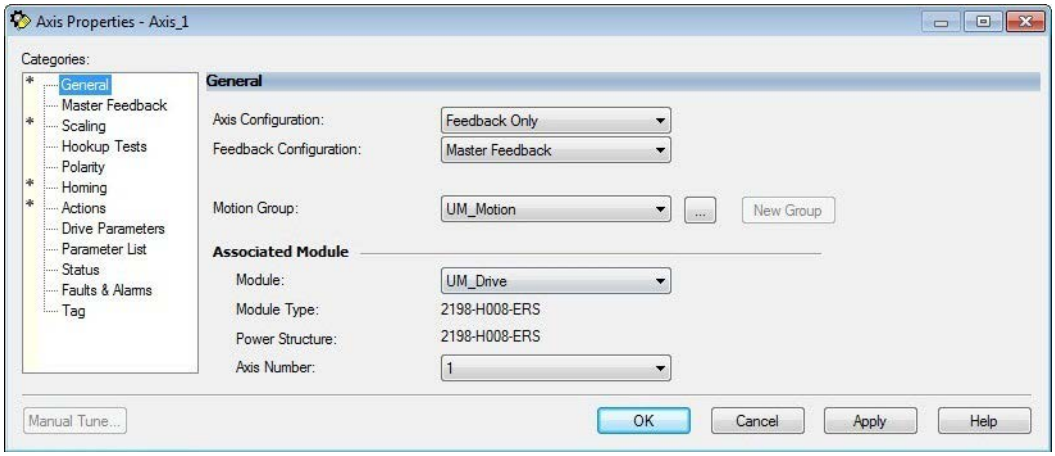
18. Click OK.

19. Repeat step 1 through step 18 for each servo motor axis.

Configure Feedback Only Axis Properties

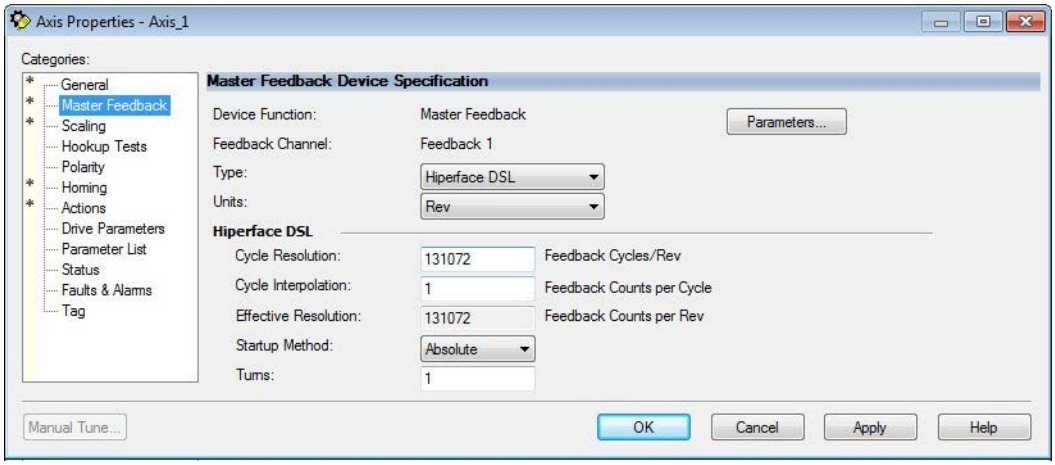
Follow these steps to configure feedback only axis properties.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.



3. From the Axis Configuration pull-down menu, choose Feedback Only.
4. From the Module pull-down menu, choose the drive or other device to associate with your Feedback Only axis.

   The Module Type and Power Structure fields populate with the chosen drive/device catalog numbers.
5. Select the Master Feedback category.



6. Configure the axis feedback device.
   a. From the Type pull-down menu, choose the feedback type.
   b. From the Units pull-down menu, choose the appropriate units.
   c. From the Startup Method pull-down menu, choose the feedback startup method.
7. Click OK.
8. Repeat step 1 through step 7 for each feedback only axis.

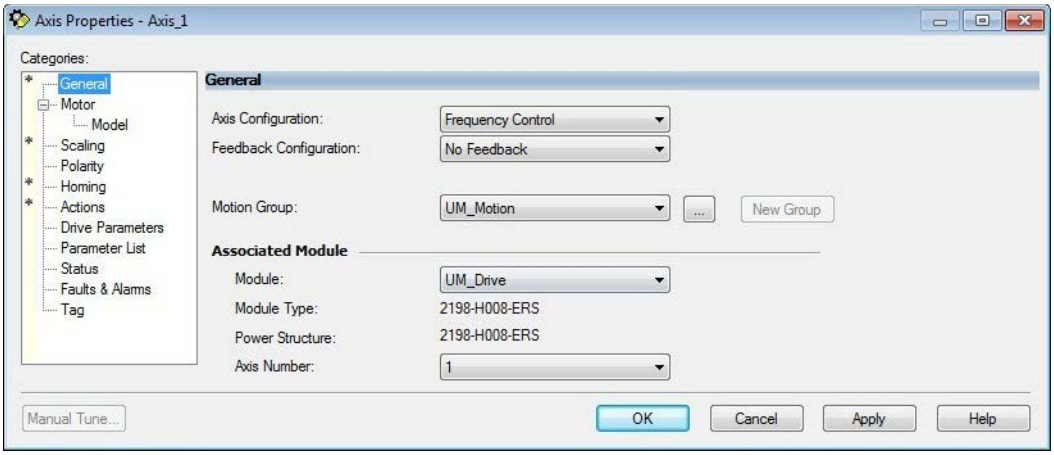
Configure Induction Motor Axis Properties

The Kinetix 5500 servo drives support basic volts/hertz and sensorless vector frequency control methods. For more information regarding frequency control methods, refer to Induction Motor Control Methods on page 171.

Follow these steps to configure induction motor axis properties.

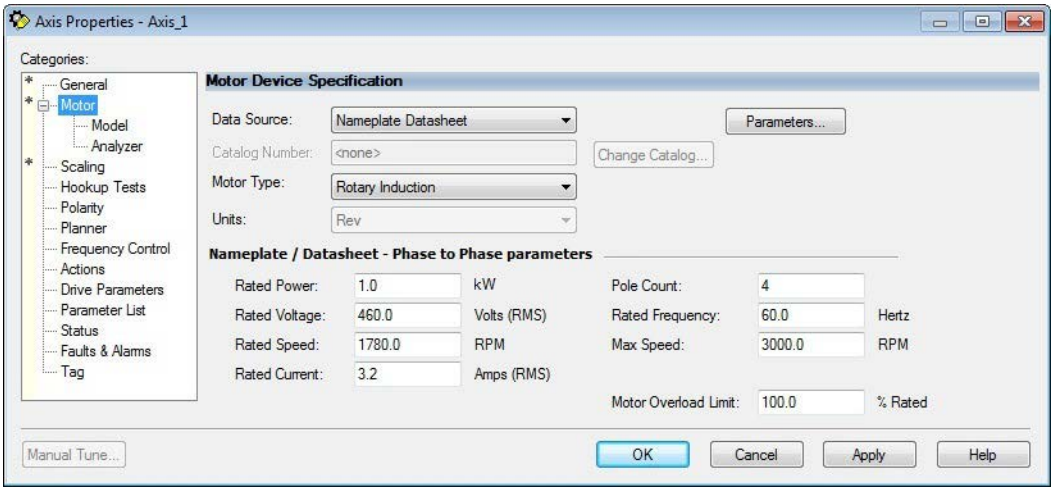
1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

   The General and Associated Module dialog box opens.



3. From the Axis Configuration pull-down menu, choose Frequency Control.
4. From the Module pull-down menu, choose the drive to associate with your Frequency Control axis.

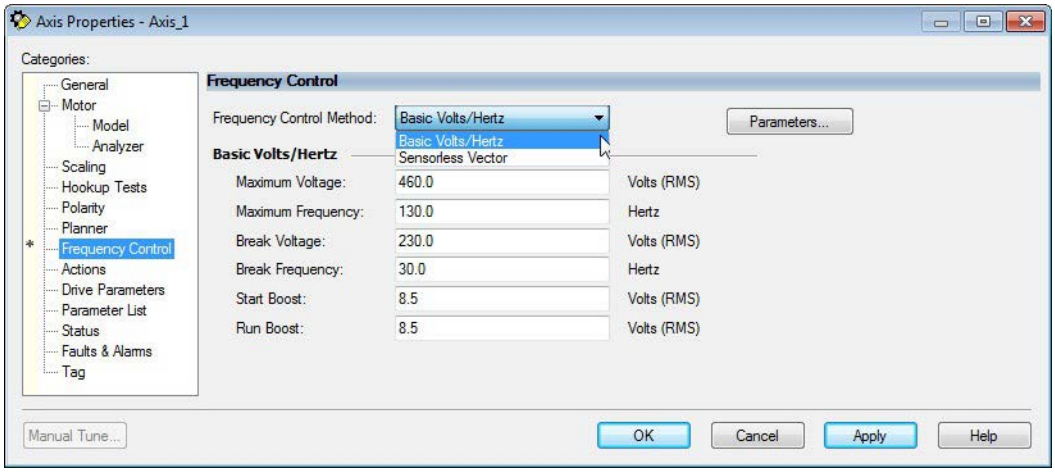
   The Module Type and Power Structure fields populate with the chosen drive catalog number.
5. Click Apply.
6. Select the Motor category.



7. From the Data Source pull-down menu, choose Nameplate Datasheet.

   This is the default setting.

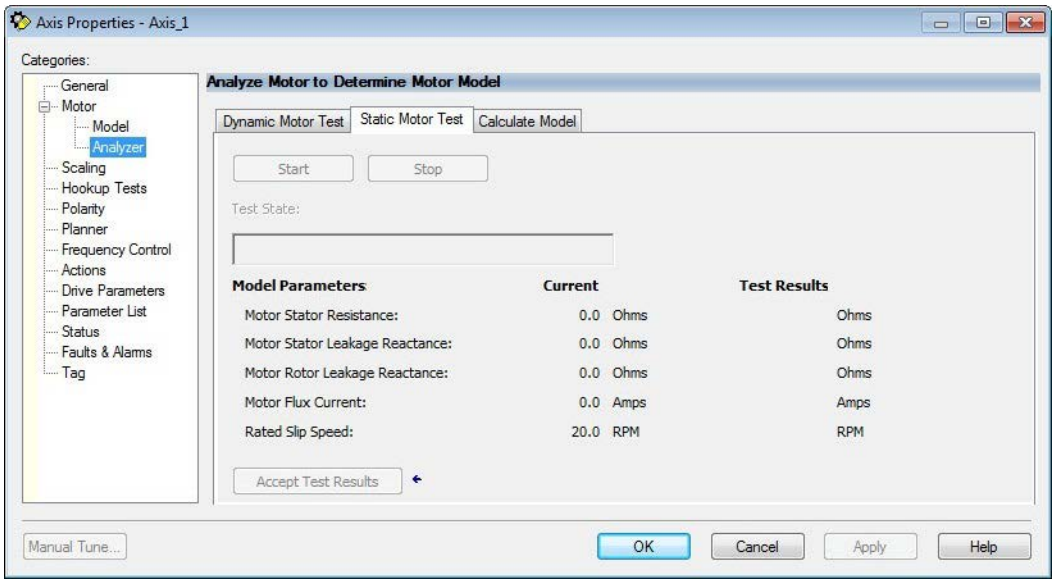
8. From the Motor Type pull-down menu, choose Rotary Induction.
9. From the motor nameplate or datasheet, enter the phase-to-phase values.
10. Click Apply.
11. Select the Frequency Control category.



12. From the Frequency Control Method pull-down menu, choose the method appropriate for your application.
13. If you chose the Basic Volts/Hertz method, enter the nameplate data for your motor in the Basic Volts/Hertz fields.

    If you chose the Sensorless Vector method, the Basic Volts/Hertz fields are dimmed.

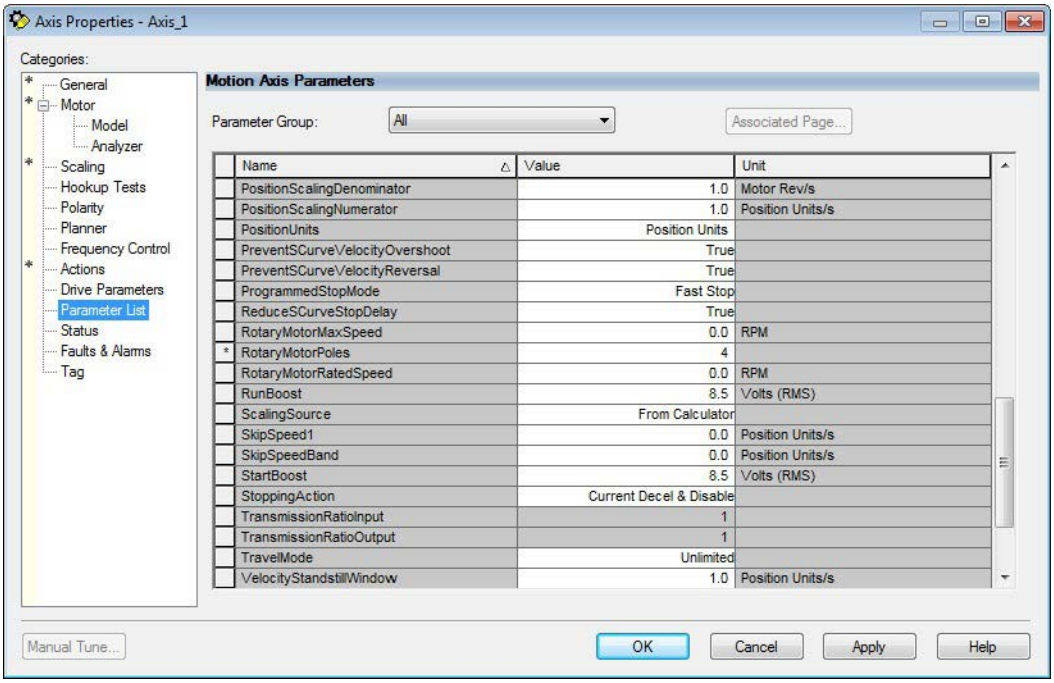
14. Click Apply.
15. If you chose the Sensorless Vector method, select the Motor>Analyzer category.



16. Click the Static Motor Test tab.
17. Click Start to run the test and measure Motor Stator Resistance.

    If you chose the Basic Volts/Hertz category, you can skip this test.
18. Select the Parameter List category.

    The Motion Axis Parameters dialog box opens.



19. Enter values for the SkipSpeed1 and SkipSpeedBand parameters.

    For more information regarding skip frequency, refer to Skip Frequency on page 174.
20. Click OK.
21. Repeat step 1 through step 20 for each induction motor axis.

Download the Program

After completing the Logix Designer application and saving the file you must download your program to the Logix5000 processor.

Apply Power to the Kinetix 5500 Drive

This procedure assumes that you have wired and configured your Kinetix 5500 system and your Logix5000 controller.

SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2198 servo drives prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

Follow these steps to apply power to the Kinetix 5500 system.

1. Disconnect the load to the motor.

   ATTENTION: To avoid personal injury or damage to equipment, disconnect the load to the motor. Make sure each motor is free of all linkages when initially applying power to the system.

2. Apply 24V DC control power.

   The LCD display begins the startup sequence. Refer to Startup Sequence on page 87. If the startup sequence does not begin, check the 24V control power connections.

3. When the startup sequence completes, verify that the two status indicators are steady green and the axis state is PRECHARGE.

   If the axis state does not reach PRECHARGE and the two status indicators are not solid green, refer to Kinetix 5500 Drive Status Indicators on page 119.

4. Apply mains input power and monitor the DC BUS voltage on the LCD display.

   If the DC BUS does not reach the expected voltage level, check the three-phase input power connections. Also, it may take as many as 1.8 seconds after input power is applied before the drive can accept motion commands.

5. Verify that the axis state changes to STOPPED.

   If the axis state does not change to STOPPED, refer to Fault Codes on page 114.

Applying Power After Changing Input Voltage Range

This step applies to any drive or multi-axis drive configuration that includes the Bulletin 2198 capacitor module.

ATTENTION: To avoid damage to equipment when the configured input voltage range of the drive or drives connected to a Bulletin 2198 capacitor module changes from 230V AC to 460V AC or from 460V AC to 230V AC, the bus voltage needs to bleed down below 50V DC before the new configured input voltage is applied.

Test and Tune the Axes

This procedure assumes that you have configured your Kinetix 5500 drive, your Logix5000 controller, and applied power to the system.

IMPORTANT Before proceeding with testing and tuning your axes, verify that the MOD and NET status indicators are operating as described in Kinetix 5500 Drive Status Indicators on page 119.

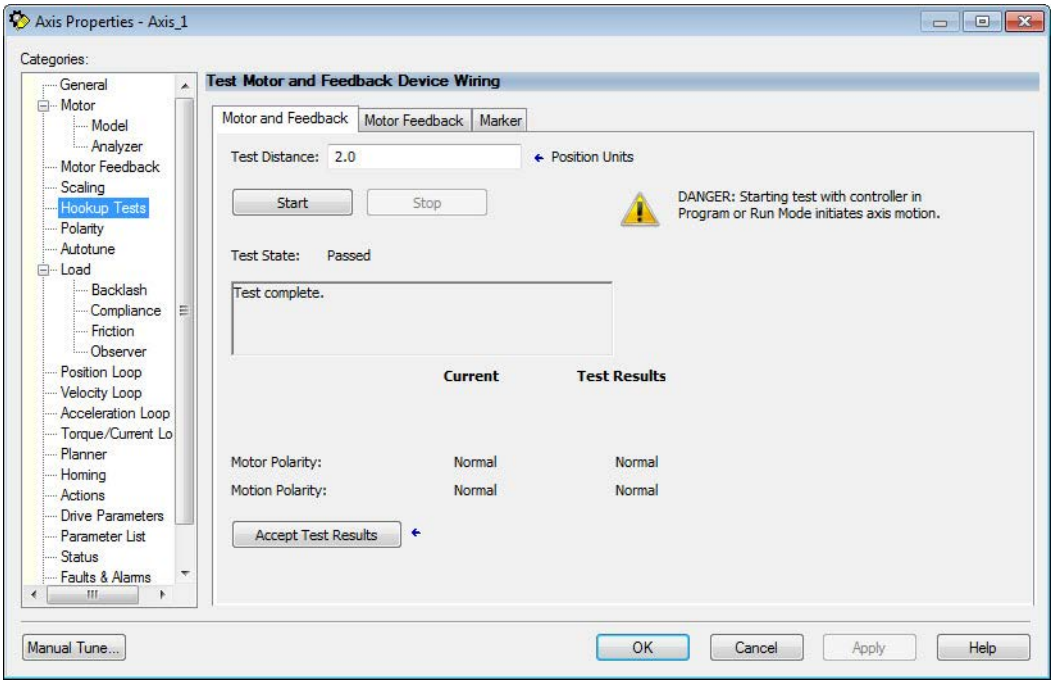
For help using the Logix Designer application as it applies to testing and tuning your axes with ControlLogix EtherNet/IP modules or CompactLogix 5370 controllers, refer to Additional Resources on page 10.

Test the Axes

Follow these steps to test the axes.

1. Verify the load was removed from each axis.
2. In your Motion Group folder, right-click an axis and choose Properties.

   The Axis Properties dialog box opens.
3. Click the Hookup Tests category.



4. In the Test Distance field, type 2.0 as the number of revolutions for the test.

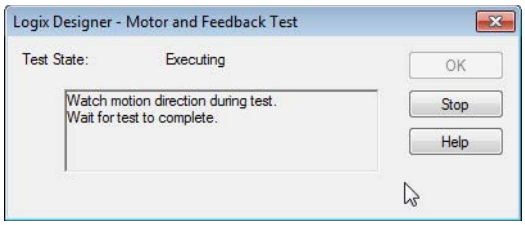
Test	Description
Marker	Verifies marker detection capability as you rotate the motor shaft.
Motor Feedback	Verifies feedback connections are wired correctly as you rotate the motor shaft.
Motor and Feedback	Verifies motor power and feedback connections are wired correctly as you command the motor to rotate.

5. Click the desired tab (Marker/Motor Feedback/Motor and Feedback).

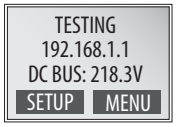
   In this example, the Motor and Feedback test is chosen.

6. Click Start.

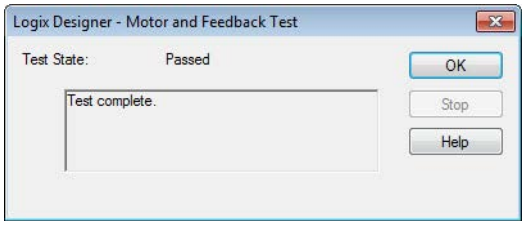
   The Logix Designer - Motor and Feedback Test dialog box opens. The Test State is Executing. TESTING appears on the drive LCD display.



Drive LCD Display

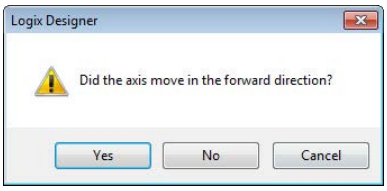


   When the test completes successfully, the Test State changes from Executing to Passed.



7. Click OK.

   This dialog box opens asking if the direction was correct.



8. Click Yes.
9. Click Accept Test Results.
10. If the test fails, this dialog box opens.

    a. Click OK.
    b. Verify the DC bus voltage.
    c. Verify unit values entered in the Scaling category.
    d. Return to step 5 and run the test again.

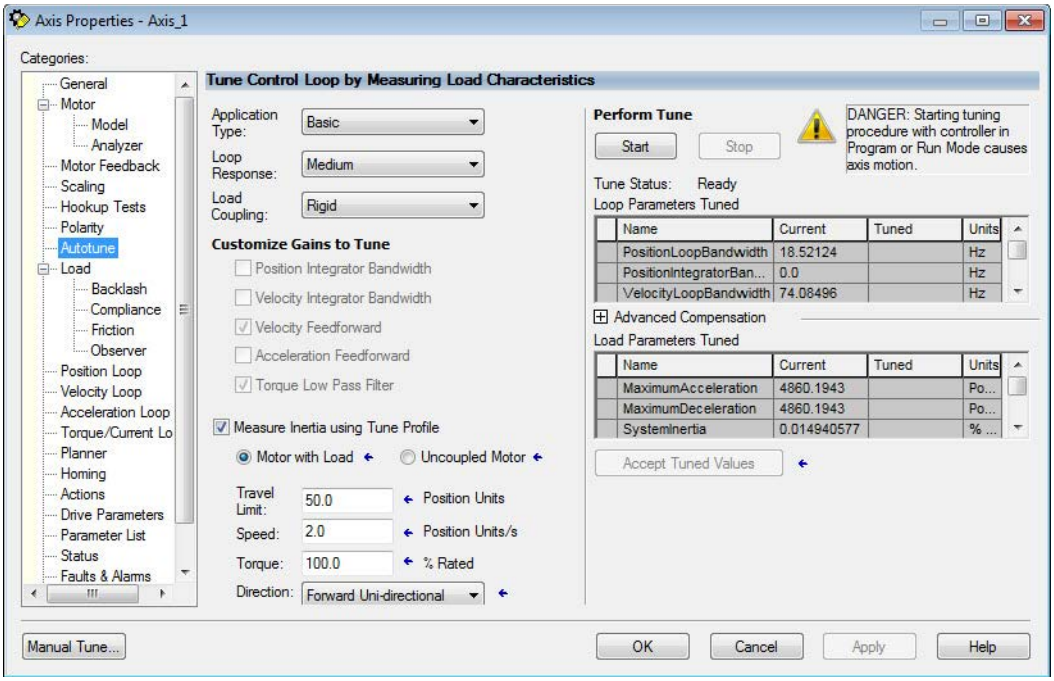
Tune the Axes

Follow these steps to tune the axes.

1. Verify the load is still removed from the axis being tuned.

> **ATTENTION:** To reduce the possibility of unpredictable motor response, tune your motor with the load removed first, then re-attach the load and perform the tuning procedure again to provide an accurate operational response.

2. Click the Autotune category.



3. Type values for Travel Limit and Speed.

   In this example, Travel Limit = 5 and Speed = 10. The actual value of programmed units depend on your application.

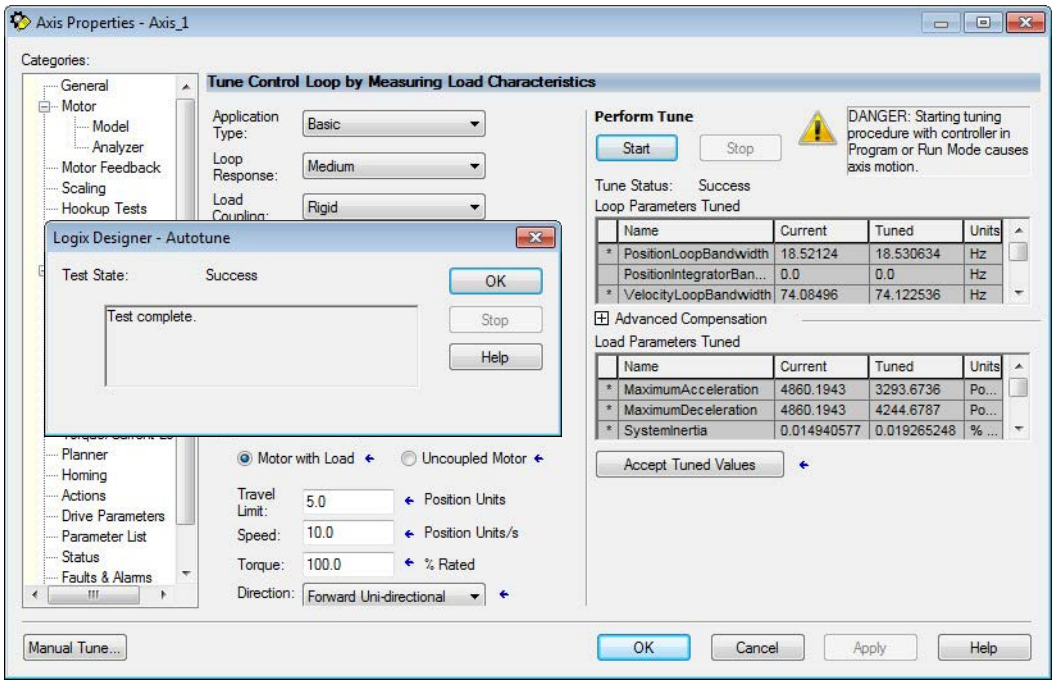
4. From the Direction pull-down menu, choose a setting appropriate for your application.

   Forward Uni-directional is default.

5. Edit other fields as appropriate for your application.

6. Click Start.

The Logix Designer - Autotune dialog box opens. When the test completes, the Test State changes from Executing to Success.



Tuned values populate the Loop and Load parameter tables. Actual bandwidth values (Hz) depend on your application and may require adjustment once motor and load are connected.

7. Click Accept Tuned Values.
8. Click OK to close the Logix Designer - Autotune dialog box.
9. Click OK to close the Axis Properties dialog box.
10. If the test fails, this dialog box opens.

a. Click OK.
b. Make an adjustment to motor velocity.
c. Refer to the controller user manual for more information.
d. Return to step 6 and run the test again.

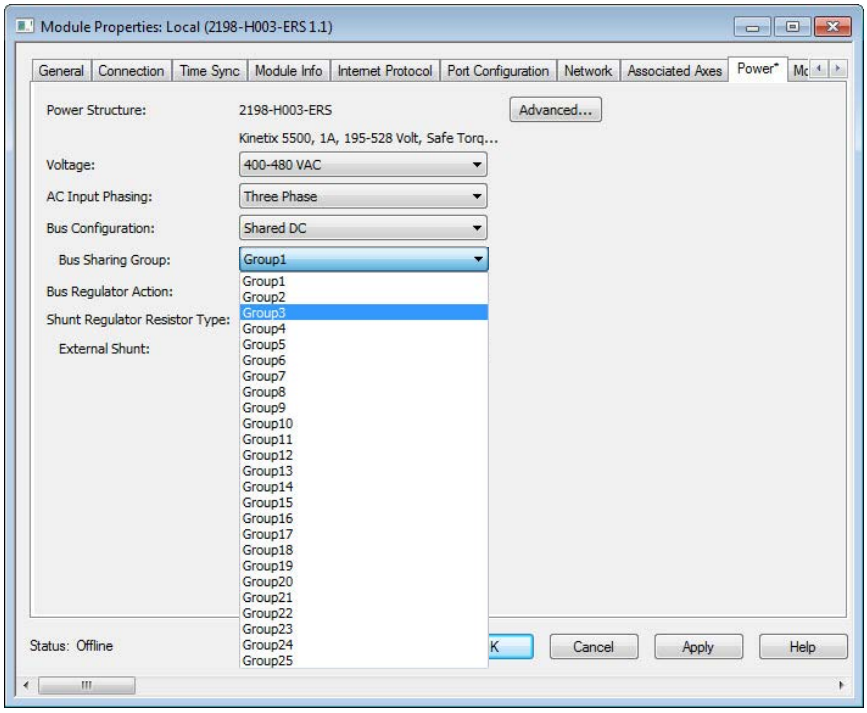
11. Repeat Test and Tune the Axes for each axis.

Understanding Bus Sharing Group Configuration

When configuring Module Properties>Power tab for each Kinetix 5500 servo drive, you can breakout drives from one or more servo systems into multiple bus-sharing (power) groups.

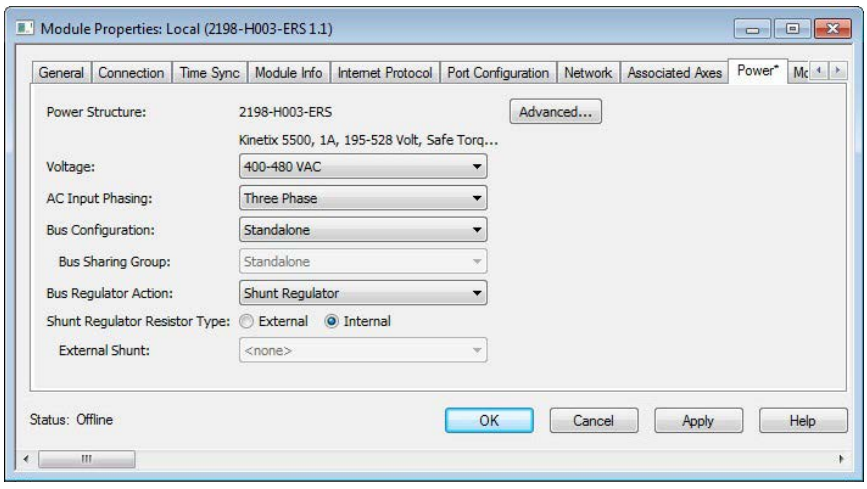
A drive that faults in Group 1 will not affect the operation of Group 2, even though all of the drives in Groups 1 and 2 are in the same Motion group in the Logix Designer application.

As many as 25 bus-sharing groups are possible.



IMPORTANT Bus-sharing groups do not apply to drives with a Bus Configuration of Standalone.

When Standalone is configured as the Bus Configuration, Standalone (dimmed) is also configured as the Bus Sharing Group.

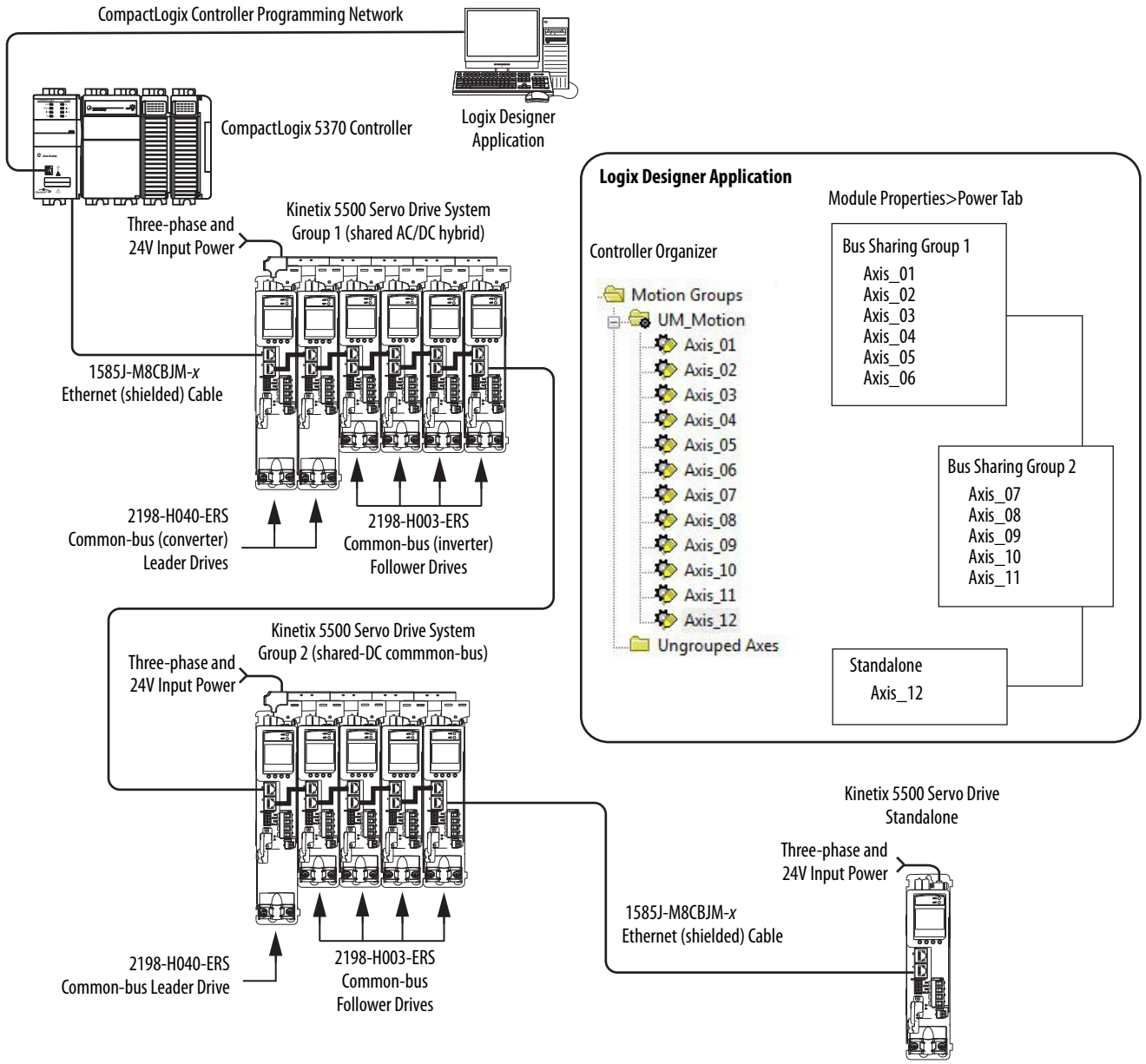


Bus Sharing Group Example

In this example, twelve axes are needed to support the motion application. All twelve axes are configured in the same Motion group in the Logix Designer application.

However, the twelve axes of motion are also configured as two bus-sharing groups and one standalone drive in Module Properties>Power tab. By creating two bus-sharing groups, a converter drive that faults in Group 1 only disables Group 1 drives, and has no effect on the drive operation of Group 2 or the Standalone drive.

Figure 49 - Bus-sharing Group Example



Configure Bus-sharing Groups

Group 1 is a shared AC/DC hybrid configuration. The Bus Configuration for the first two converter drives is Shared AC/DC. The Bus Configuration for the inverter drives is Shared DC.

Figure 50 - Group 1 Converter Drives Configuration

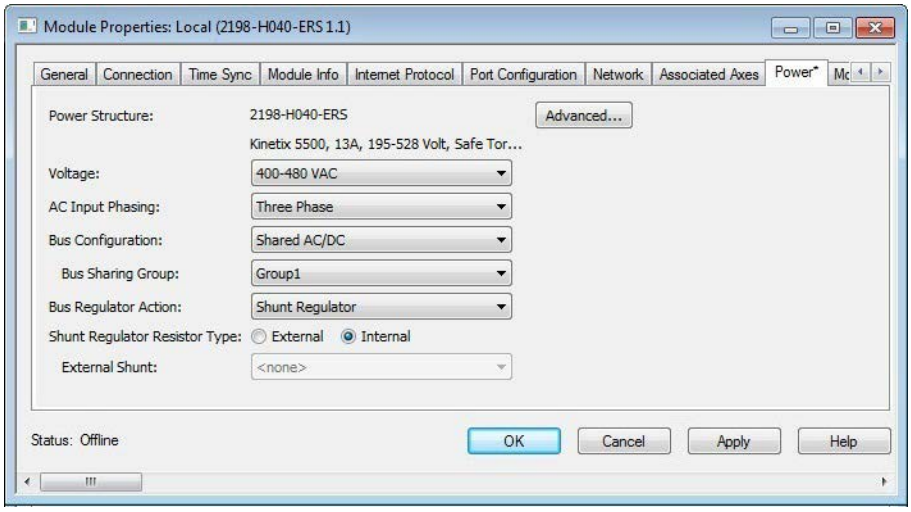
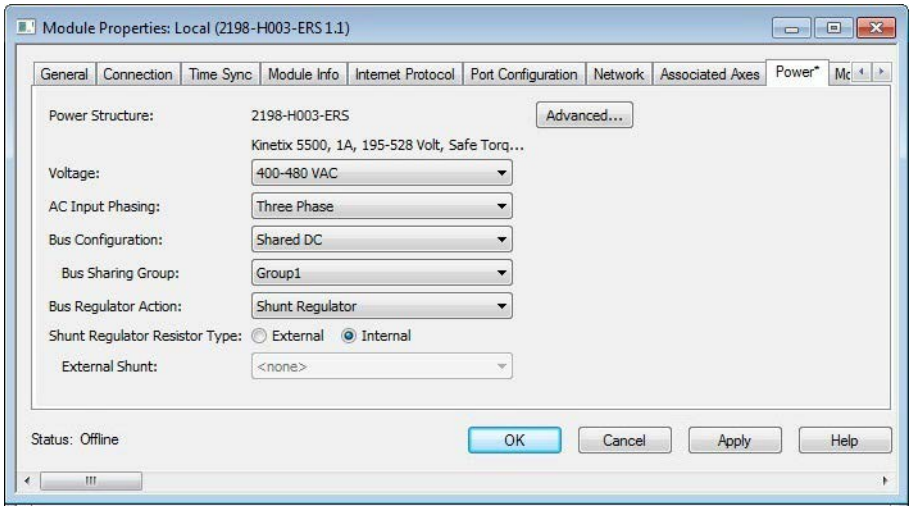


Figure 51 - Group 1 Inverter Drives Configuration



Group 2 is a shared DC (common-bus) configuration. The Bus Configuration for the leader drive is Shared AC/DC. The Bus Configuration for the follower drives is Shared DC.

Figure 52 - Group 2 Leader Drive Configuration

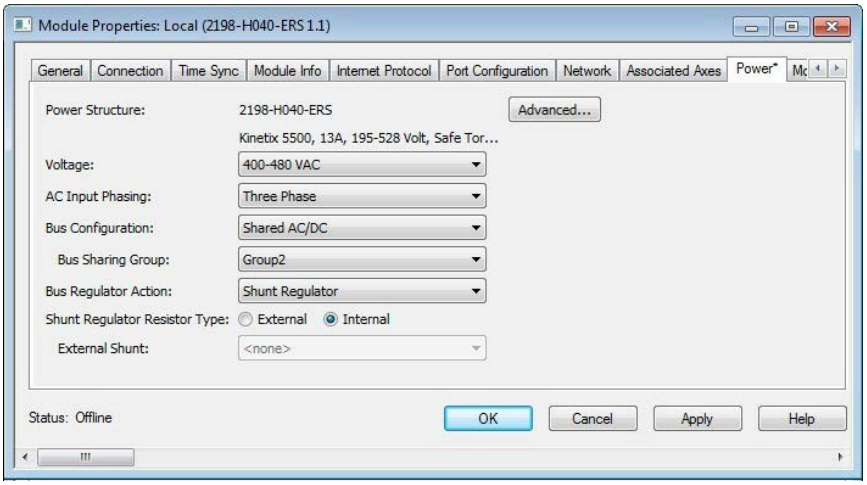


Figure 53 - Group 2 Follower Drives Configuration

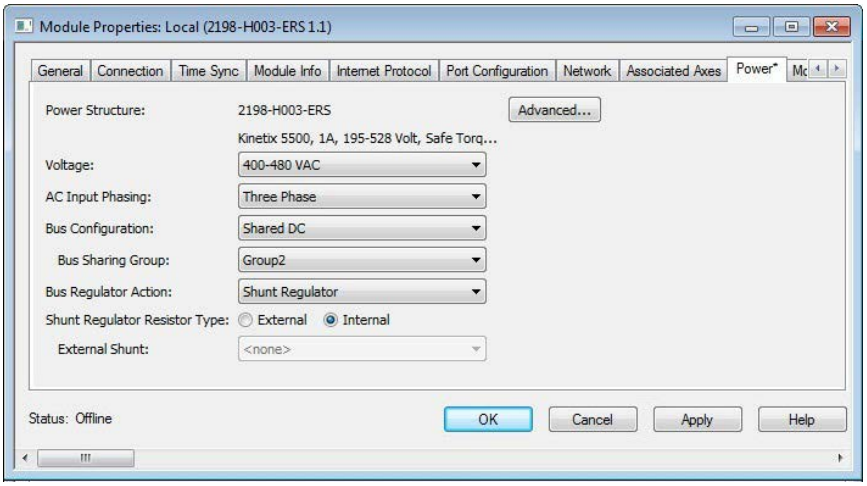
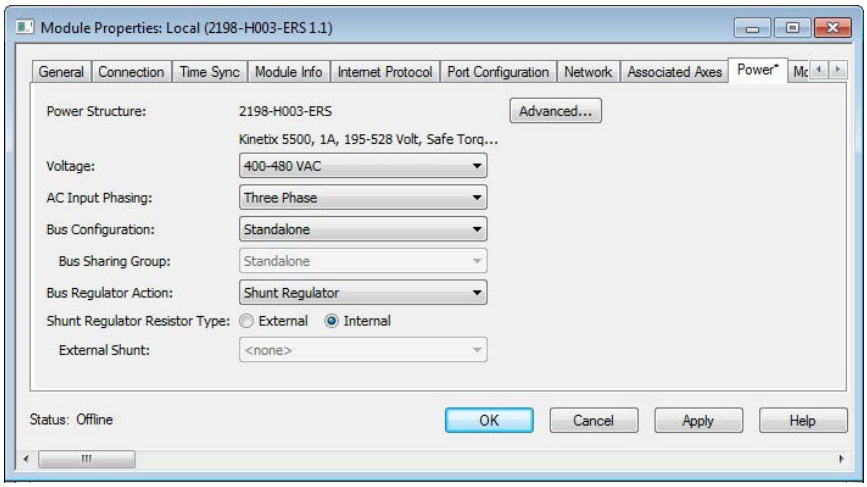


Figure 54 - Standalone Drive Configuration



Troubleshooting the Kinetix 5500 Drive System

This chapter provides troubleshooting tables and related information for your Kinetix 5500 servo drives.

Topic	Page
Safety Precautions	113
Interpret Status Indicators	114
General Troubleshooting	120
Logix5000 Controller and Drive Behavior	122

Safety Precautions

Observe the following safety precautions when troubleshooting your Kinetix 5500 servo drive.

ATTENTION: Capacitors on the DC bus may retain hazardous voltages after input power has been removed. Before working on the drive, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Do not attempt to defeat or override the drive fault circuits. You must determine the cause of a fault and correct it before you attempt to operate the system. Failure to correct the fault could result in personal injury and/or damage to equipment as a result of uncontrolled machine operation.

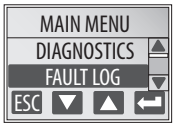
ATTENTION: Provide an earth ground for test equipment (oscilloscope) used in troubleshooting. Failure to ground the test equipment could result in personal injury.

Interpret Status Indicators

Refer to these troubleshooting tables to identify faults, potential causes, and the appropriate actions to resolve the fault. If the fault persists after attempting to troubleshoot the system, please contact your Rockwell Automation sales representative for further assistance.

Display Interface

The LCD display provides fault messages and troubleshooting information by using the soft menu items and navigation buttons.



Refer to Understanding the Kinetix 5500 Display on page 84 for more information on navigating the LCD display menu.

Use these soft menu items to access the fault log and troubleshooting information.

LOG	Press to display the list of active fault codes.
TEXT	Press to display the fault text (exception code in troubleshooting tables).
INFO	Press to display the fault details (the problem in troubleshooting tables).
HELP	Press to display the fault help (possible solutions in troubleshooting tables).

Fault Codes

The fault code tables are designed to help you determine the source of the fault or exception. When a fault condition is detected, the drive performs the appropriate fault action, the fault is displayed, and the fault is added to a persistent fault log (along with diagnostics data). The earlier faults have priority to be displayed.

The drive removes the fault text from the display when a Fault Reset service is sent from the controller and the fault is no longer active. If a fault is still active following a Fault Reset service, the fault is again posted to the display and written to the fault log.

The drive maintains a log of the last 25 faults with time stamps and stores the fault log in persistent memory. However, the fault log cannot be cleared on the drive.

Table 41 - Fault Code Summary

Fault Code Type	Description
FLT S*xx*	Standard runtime axis exceptions.
FLT M*xx*	
INIT FLT S*xx*	Exceptions that prevent normal operation and occur during the initialization process.
INIT FLT M*xx*	
NODE FLT*xx*	Exceptions that prevent normal operation of the drive.
NODE ALARM *xx*	Exceptions that prevent normal operation of the drive, but do not result in any action other than reporting the alarm to the controller.
INHIBIT M*xx*	Exceptions that prevent normal operation and indicate whenever the drive is active.

Refer to Chapter 9 on page 131 for information on troubleshooting SAFE FLT fault codes.

TIP Fault codes triggered by conditions that fall outside factory set limits are identified by FL at the end of the display message. For example, FLT S07 – MTR OVERLOAD FL.

Fault codes triggered by conditions that fall outside user set limits are identified by UL at the end of the display message. For example, FLT S08 – MTR OVERLOAD UL.

Table 42 - FLT S*xx* Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT S03 – MTR OVERSPEED FL	Motor Overspeed Factory Limit Fault	Motor speed has exceeded 125% of its maximum speed.	Check control loop tuning.
FLT S05 – MTR OVERTEMP FL	Motor Overtemperature Factory Limit Fault	Calculations based on the motor thermistor indicate that the motor factory temperature limit has been exceeded.	• Operate motor within continuous torque rating • Reduce motor ambient temperature • Add motor cooling Available only on Kinetix VP (Bulletin VPL) motors. Not supported on induction motors.
FLT S07 – MTR OVERLOAD FL	Motor Thermal Overload Factory Limit Fault	The motor thermal model has exceeded its factory set thermal capacity limit of 110%.	Modify the command profile to reduce speed or increase time.
FLT S08 – MTR OVERLOAD UL	Motor Thermal Overload User Limit Fault	The motor thermal model has exceeded the thermal capacity limit given by Motor Thermal Overload User Limit.	• Modify the command profile • Increase the Motor Thermal Overload UL attribute value
FLT S10 – INV OVERCURRENT	Inverter Overcurrent Fault	Inverter current has exceeded the instantaneous current limit (determined by hardware).	• Check motor power cable for shorts • Verify motor windings are not shorted • Verify motor power wire gauge • Operate within the continuous power rating • Reduce acceleration times
FLT S11 – INV OVERTEMP FL	Inverter Overtemperature Factory Limit Fault	The measured inverter temperature has exceeded the factory set temperature limit.	• Modify the command profile to reduce speed or increase time • Reduce drive ambient temperature • Verify airflow through drive is not obstructed
FLT S13 – INV OVERLOAD FL	Inverter Thermal Overload Factory Limit Fault	The thermal model for the power transistors indicates that the temperature has exceeded the factory set thermal capacity rating of 110%.	Modify the command profile to reduce speed or increase time.
FLT S14 – INV OVERLOAD UL	Inverter Thermal Overload User Limit Fault	The thermal model for the power transistors indicates that the temperature has exceeded the limit given by Inverter Thermal Overload User Limit.	Modify the command profile to reduce speed or increase time.
FLT S15 – CONV OVERCURRENT	Converter Overcurrent Fault	The measured converter current has exceeded the factory set current limit.	• Reduce acceleration times of all drives sharing the DC bus • Reduce number of shared DC follower drives • Reduce number of capacitor modules
FLT S16 – GROUND CURRENT	Ground Current Factory Limit Fault	The sensing circuitry in the power stage has detected excessive ground current.	• Check motor power wiring; check power cable for shorts • Replace motor if the fault persists
FLT S18 – CONV OVERTEMP FL	Converter OverTemp Factory Limit Fault	The measured converter temperature has exceeded the factory set temperature limit.	• Reduce acceleration times of all drives sharing the DC bus • Reduce number of shared DC follower drives • Modify the command profile to reduce speed or increase time • Reduce drive ambient temperature • Verify airflow through drive is not obstructed

Table 42 - FLT *Sxx* Fault Codes (continued)

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT S20 – CONV OVERLOAD FL	Converter Thermal Overload Factory Limit Fault	The converter thermal model indicates that the temperature has exceeded the factory set capacity rating of 110%.	• Reduce acceleration times of all drives sharing the DC bus • Reduce number of shared DC follower drives • Reduce duty-cycle of commanded motion
FLT S21 – CONV OVERLOAD UL	Converter Thermal Overload User Limit Fault	The converter thermal model indicates that the temperature has exceeded the limit given by Converter Thermal Overload User Limit.	• Reduce acceleration times of all drives sharing the DC bus • Reduce number of shared DC follower drives • Reduce duty-cycle of commanded motion • Increase the Converter Thermal Overload UL attribute value
FLT S23 – AC PHASE LOSS	AC Single Phase Loss Fault	A single AC input phase was lost while the drive was enabled.	Check AC input voltage on all phases.
FLT S25 – PRECHARGE FAILURE	Pre-charge Failure Fault	The pre-charge circuit monitoring algorithm detected that the DC bus did not reach a factory set voltage level after charging for a period of time.	• Check AC input voltage on all phases • Check input power wiring • Replace drive if fault persists
FLT S29 – BUS OVERLOAD FL	Bus Regulator Thermal Overload Factory Limit Fault	The shunt thermal model has exceeded its factory set thermal capacity limit.	• Modify the duty cycle of the application • Add external shunt for additional capacity • Add capacitor module if needed
FLT S30 – BUS OVERLOAD UL	Bus Regulator Thermal Overload User Limit Fault	The shunt thermal model has exceeded the thermal capacity limit given by Bus Regulator Thermal Overload User Limit.	• Modify the duty cycle of the application • Add external shunt for additional capacity • Increase the Bus Regulator Thermal Overload UL attribute value
FLT S31 – BUS REGULATOR	Bus Regulator Failure	The shunt driver IC has detected that the shunt resistor is shorted.	• Check for shorts in the shunt connector • Unplug the shunt connector and measure the resistance of the shunt • Replace drive if shunt resistor is shorted
FLT S33 – BUS UNDERVOLT FL	Bus Undervoltage Factory Limit Fault	DC Bus voltage level is below the factory set limit as determined by the configured input voltage.	• Verify voltage level of the incoming AC • Monitor AC power source for glitches or line droop • Install UPS on AC input
FLT S34 – BUS UNDERVOLT UL	Bus Undervoltage User Limit Fault	DC Bus voltage level is below the user set limit as given by Bus Undervoltage User Limit.	• Verify voltage level of the incoming AC • Monitor AC power source for glitches or line droop • Install UPS on AC input • Increase Bus Undervoltage UL attribute value
FLT S35 – BUS OVERVOLT FL	Bus Overvoltage Factory Limit Fault	DC Bus voltage level is above the factory set limit as determined by the configured input voltage.	• Change the deceleration or motion profile of all drives connected to the DC bus • Unplug the shunt connector and measure the resistance of the shunt • Replace drive if shunt resistor is open
FLT S39 – BUS POWER LEAK	Bus Power Leakage Fault	Measured converter power exceeded estimated inverter output power by more than a factory limit.	• Check bus power sharing configuration attribute • Check AC input and DC bus sharing connections
FLT S45 – FDBK COMM FL	Motor Feedback Data Loss Factory Limit Fault	The number of consecutive missed or corrupted serial data packets from the intelligent feedback device has exceeded a factory set limit.	• Check motor feedback cable and connector • Check motor power cable and feedback wire shields are secured correctly • Check motor frame is grounded correctly
FLT S47 – FDBK DEVICE FAILURE	Feedback Device Failure	The feedback device has detected an internal error.	• Check motor feedback cable and connector • Cycle control power • Replace motor if fault continues • Check feedback shield connection • Reduce shock and vibration to motor
FLT S54 – POSN ERROR	Excessive Position Error Fault	The position error of the position control loop has exceeded the value given by Position Error Tolerance for a time period given by Position Error Tolerance Time.	• Check position loop tuning • Increase the feedforward gain • Verify sizing of the drive and motor • Check motor power wiring • Increase Position Error Tolerance and/or Position Error Tolerance Time attribute values
FLT S55 – VEL ERROR	Excessive Velocity Error Fault	The velocity error of the velocity control loop has exceeded the value given by Velocity Error Tolerance for a time period given by Velocity Error Tolerance Time.	• Check velocity loop tuning • Reduce acceleration • Verify sizing of the drive and motor • Check motor power wiring • Increase Velocity Error Tolerance and/or Velocity Error Tolerance Time attribute values
FLT S56 – OVERTORQUE LIMIT	Overtorque Limit Fault	Motor torque has risen above user defined maximum torque level given by Overtorque Limit for a time period given by Overtorque Limit Time.	• Verify Torque Trim value • Verify motion profile • Verify sizing of the drive and motor • Increase Overtorque Limit and/or Overtorque Limit Time attribute values
FLT S57 – UNDERTORQUE LIMIT	Undertorque Limit Fault	Motor torque has dropped below user defined minimum torque level given by Undertorque Limit for a time period given by Undertorque Limit Time.	• Verify motion profile • Verify sizing of the drive and motor • Decrease Undertorque Limit and/or Undertorque Limit Time attribute values

Table 43 - FLT M*xx* Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT M02 – MOTOR VOLTAGE	Motor Voltage Mismatch Fault	The configured voltage of the drive is greater than the motor rated voltage. For example, a 400V-class drive with a 200V-class motor.	Set the drive voltage to a lower value or replace motor with voltage rating that matches the drive.
FLT M14 – CURR FDBK OFFSET	Excessive Current Feedback Offset Fault	The calibration for the phase current feedback sensors required excessive offset to compensate.	• Cycle control power • Return drive for repair if fault continues
FLT M25 – COMMON BUS	DC Common Bus Fault	AC power was detected by the drive while configured for shared DC operation.	• Check the drive power configuration from controller • Check wiring
FLT M26 – RUNTIME ERROR	Runtime Error	The drive firmware encountered an unrecoverable runtime error.	• Cycle control power • Reset the drive • Return drive for repair if fault continues

Table 44 - INIT FLT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
INIT FLT S03 – NVMEM CHKSUM	Nonvolatile memory checksum error	Data in the nonvolatile memory has a checksum error.	• Cycle control power • Reset the drive • Return drive for repair if fault continues
INIT FLT M01 – ENCODER DATA	Smart Encoder Data Corruption	The data stored in the encoder has a checksum error.	• Cycle control power • Return motor for repair if fault continues
INIT FLT M02 – MTR DATA RANGE	Motor Data Range Error	A motor data attribute stored in the encoder is out of range.	• Cycle control power • Return motor for repair if fault continues
INIT FLT M03 – MTR ENC STARTUP	Motor Feedback Communication Startup	Communication with the encoder could not be established.	• Cycle control power • Check motor feedback connector • Check motor power and feedback shield terminations on the drive • Return motor for repair if fault continues
INIT FLT M20 – UNKNOWN MODULE	Unknown Module	The product code of the power board is invalid.	• Cycle control power • Reset the drive • Return drive for repair if fault continues
INIT FLT M21 – FACTORY CONFIG	Factory Configuration	Factory configuration data is missing or invalid	• Cycle control power • Reset the drive • Return drive for repair if fault continues

Table 45 - INHIBIT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
INHIBIT S02 – MOTOR NOT CONFIGURED	Motor Not Configured	The motor has not been properly configured for use.	Verify motor configuration in the Logix Designer application.
INHIBIT S03 – FEEDBACK NOT CONFIGURED	Feedback Not Configured	The feedback has not been properly configured for use.	Verify feedback configuration in the Logix Designer application.
INHIBIT M05 – SAFE TORQUE OFF	Start Inhibit – Safe Torque Off	The safety function has disabled the power structure.	• Check safety input wiring • Check state of safety devices

Table 46 - NODE FLT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
NODE FLT 01 – LATE CTRL UPDATE	Control Connection Update Fault	Several consecutive updates from the controller have been lost.	• Remove unnecessary network devices from the motion network • Change network topology so that fewer devices share common paths • Use high performance network equipment • Use shielded cables • Separate signal wiring from power wiring
NODE FLT 02 – PROC WATCHDOG	Processor Watchdog Fault	The processor on the power board or control board failed to update in a certain amount of time.	• Cycle control power • Update the drive firmware • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 00	Hardware Fault -PwrIF	Communication with the power board could not be established.	• Cycle control power • Update the drive firmware • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 01	Hardware Fault - DSL	Communication with the encoder could not be established.	• Cycle control power • Return motor for repair if fault continues
NODE FLT 05 – CLOCK SKEW FLT	Clock Skew Fault	The controller time and the drive's system time are not the same.	• Cycle control power • Check controller and Ethernet switch operation
NODE FLT 06 – LOST CTRL CONN	Lost Controller Connection Fault	Communication with the controller has been lost.	• Check Ethernet connection • Check controller and Ethernet switch operation
NODE FLT 07 – CLOCK SYNC	Clock Sync Fault	Drive's local clock has lost synchronization with controller's clock and was not able to resynchronize within allotted time.	• Check Ethernet connection • Check controller and Ethernet switch operation
NODE FLT 09 – DUPLICATE IP ADDRESS	Duplicate IP Address Fault	Several consecutive updates from the controller have been lost.	Select an IP address not already in use on the network.

Table 47 - NODE ALARM Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
NODE ALARM 01 – LATE CTRL UPDATE	Control Connection Update Alarm	Updates from the controller have been late.	• Remove unnecessary network devices from the motion network • Change network topology so that fewer devices share common paths • Use high performance network equipment • Use shielded cables • Separate signal wiring from power wiring
NODE ALARM 03 – CLOCK JITTER	Clock Jitter Alarm	The sync variance has exceeded the sync threshold while the device is running in sync mode.	• Check the Ethernet connection • Check controller and Ethernet switch operation
NODE ALARM 05 – CLOCK SYNC ALARM	Clock Sync Alarm	Drive's local clock has lost synchronization with controller's clock for a short time during synchronous operation.	• Check the Ethernet connection • Check controller and Ethernet switch operation

Kinetix 5500 Drive Status Indicators

The module status and network status indicators are located just above the LCD status display.

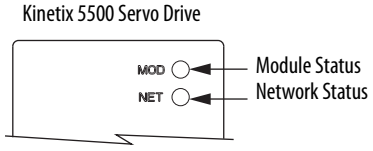


Table 48 - Module Status Indicator

Condition	Status
Steady Off	No power applied to the drive.
Steady Green	Drive is operational. No faults or failures.
Flashing Green	Standby (drive not configured).
Flashing Red	Major recoverable fault. The drive detected a recoverable fault, for example, an incorrect or inconsistent configuration.
Steady Red	Major fault. The drive detected a non-recoverable fault.
Flashing Green/Red	Self-test. The drive performs self-test during powerup.

Table 49 - Network Status Indicator

Condition	Status
Steady Off	No power applied to the drive or IP address is not configured.
Flashing Green	Drive connection is not established, but has obtained an IP address.
Steady Green	Drive connection is established. Normal operation.
Flashing Red	Connection timeout. One or more of the connections, for which this drive is the target, has timed out.
Steady Red	Duplicate IP address. IP address specified is already in use.
Flashing Green/Red	Self-test. The drive performs self-test during powerup.

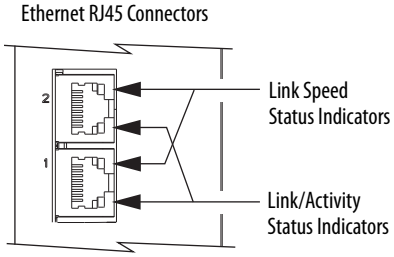


Table 50 - Ethernet Link Speed Status Indicator

Condition	Status
Steady Off	10 Mbit
Steady On	100 Mbit

Table 51 - Ethernet Link/Activity Status Indicator

Condition	Status
Steady Off	No link
Steady On	Link established
Blinking	Network activity

Kinetix 5500 Capacitor Module Status Indicators

The capacitor module status indicator and module status (MS) connector are located on the front of the module. The module status connector is a relay output suitable for wiring to the Logix5000 controller.

Kinetix 5500 Capacitor Module

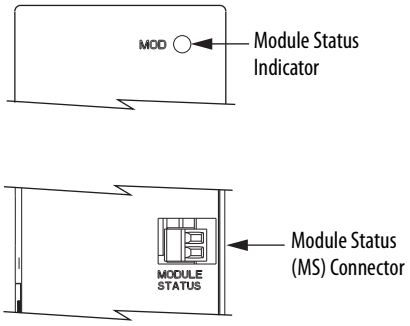


Table 52 - Module Status Indicator and Relay Output

Module Status Indicator	Relay Output (1)	Status	Resolution
Steady Green	Closed	Bus is fully charged and no faults exist.	N/A
Flashing Green	Open	Control power is present and bus is waiting to charge up.	N/A
Flashing Red	Open	Recoverable fault (precharge or overvoltage fault).	• Cycle control and bus power • Verify that AC input meets specificatons
Steady Red	Open	Internal, non-recoverable fault condition inside the module.	• Cycle control and bus power • Verify that AC input meets specificatons • Replace the module if fault persists

(1) Wiring the module status relay output to the Logix5000 controller is optional.

General Troubleshooting

These conditions do not always result in a fault code, but may require troubleshooting to improve performance.

Table 53 - General Troubleshooting

Condition	Potential Cause	Possible Resolution
Axis or system is unstable.	The position feedback device is incorrect or open.	Check wiring.
	Unintentionally in Torque mode.	Check to see what primary operation mode was programmed.
	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.
	Position loop gain or position controller accel/decel rate is improperly set.	Run Tune in the Logix Designer application.
	Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.	Check wiring and ground.
	Motor Select limit is incorrectly set (servo motor is not matched to axis module).	• Check setups. • Run Tune in the Logix Designer application.
	Mechanical resonance.	Notch filter or output filter may be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).
You cannot obtain the motor acceleration/deceleration that you want.	Torque Limit limits are set too low.	Verify that torque limits are set properly.
	Incorrect motor selected in configuration.	Select the correct motor and run Tune in the Logix Designer application again.
	The system inertia is excessive.	• Check motor size versus application need. • Review servo system sizing.
	The system friction torque is excessive.	Check motor size versus application need.
	Available current is insufficient to supply the correct accel/decel rate.	• Check motor size versus application need. • Review servo system sizing.
	Acceleration limit is incorrect.	Verify limit settings and correct them, as necessary.
	Velocity Limit limits are incorrect.	Verify limit settings and correct them, as necessary.

Table 53 - General Troubleshooting (continued)

Condition	Potential Cause	Possible Resolution
Motor does not respond to a command.	The axis cannot be enabled until stopping time has expired.	Disable the axis, wait for 1.5 seconds, and enable the axis.
	The motor wiring is open.	Check the wiring.
	The motor cable shield connection is improper.	• Check feedback connections. • Check cable shield connections.
	The motor has malfunctioned.	Repair or replace the motor.
	The coupling between motor and machine has broken (for example, the motor moves, but the load/machine does not).	Check and correct the mechanics.
	Primary operation mode is set incorrectly.	Check and properly set the limit.
	Velocity or torque limits are set incorrectly.	Check and properly set the limits.
	Brake connector not wired	Check brake wiring
Presence of noise on command or motor feedback signal wires.	Recommended grounding per installation instructions have not been followed.	• Verify grounding. • Route wire away from noise sources. • Refer to System Design for Control of Electrical Noise, publication GMC-RM001.
	Line frequency may be present.	• Verify grounding. • Route wire away from noise sources.
	Variable frequency may be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew, and so forth. The frequency may be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance.	• Decouple the motor for verification. • Check and improve mechanical performance, for example, the gearbox or ballscrew mechanism.
No rotation	The motor connections are loose or open.	Check motor wiring and connections.
	Foreign matter is lodged in the motor.	Remove foreign matter.
	The motor load is excessive.	Verify the servo system sizing.
	The bearings are worn.	Return the motor for repair.
	The motor brake is engaged (if supplied).	• Check brake wiring and function. • Return the motor for repair.
	The motor is not connect to the load.	Check coupling.
Motor overheating	The duty cycle is excessive.	Change the command profile to reduce accel/decel or increase time.
	The rotor is partially demagnetized causing excessive motor current.	Return the motor for repair.
Abnormal noise	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.
	Loose parts are present in the motor.	• Remove the loose parts. • Return motor for repair. • Replace motor.
	Through bolts or coupling is loose.	Tighten bolts.
	The bearings are worn.	Return motor for repair.
	Mechanical resonance.	Notch filter may be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).
Erratic operation - Motor locks into position, runs without control or with reduced torque.	Motor power phases U and V, U and W, or V and W reversed.	Check and correct motor power wiring.

Logix5000 Controller and Drive Behavior

By using the Logix Designer application, you can configure how the Kinetix 5500 drives respond when a drive fault/exception occurs.

TIP The INIT FLT *xxx* faults are always generated after powerup, but before the drive is enabled, so the stopping behavior does not apply.

NODE ALARM *xxx* faults do not apply because they do not trigger stopping behavior.

The drive supports fault behavior for Ignore, Alarm, Minor Fault, and Major Fault as defined in Table 54 and according to fault behavior tables beginning on page 123.

The drive supports these configurable stopping actions:

- Disable and Coast
- Decel and Disable
- Decel and Hold

Kinetix 5500 Drive Exception Behavior

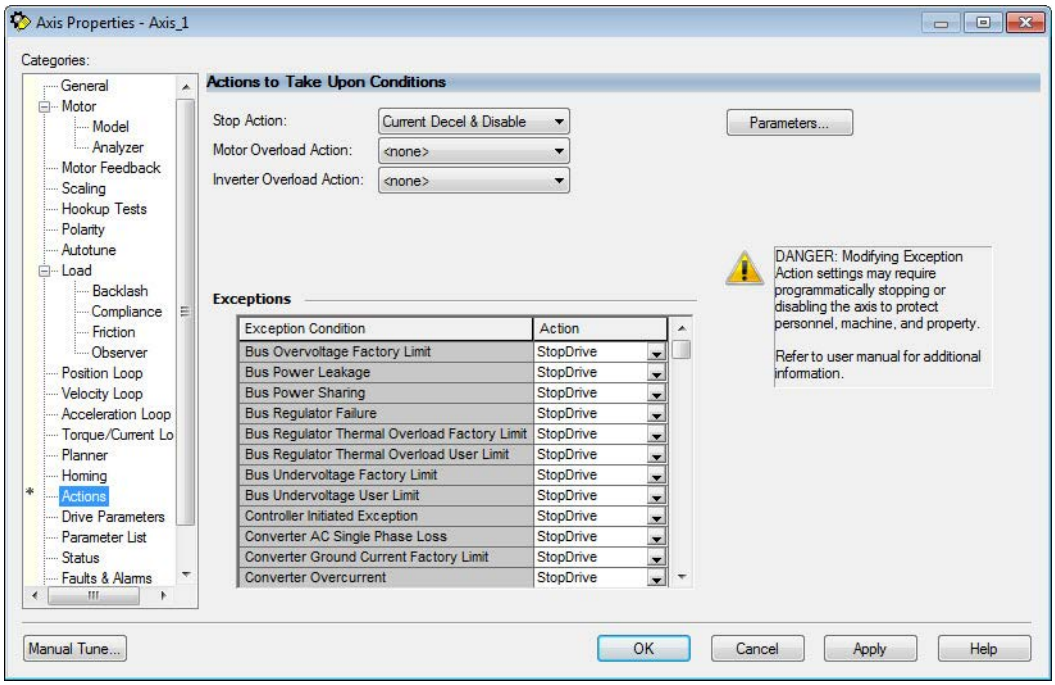
For Kinetix 5500 drives, you can configure exception behavior in the Logix Designer application from the Axis Properties dialog box, Actions category.

Table 54 - Kinetix 5500 Drive Exception Action Definitions

Exception Action	Definition
Ignore	The controller completely ignores the exception condition. For some exceptions that are fundamental to the operation of the planner, Ignore will not be an available option.
Alarm	The controller sets the associated bit in the Motion Alarm Status word but does not otherwise affect axis behavior. Like Ignore, if the exception is so fundamental to the drive, Alarm will not be an available option. When an exception action is set to Alarm, the Alarm will go away by itself when the exceptional condition has cleared.
Fault Status Only	Like Alarm, Fault Status Only instructs the controller to set the associated bit in the Motion Fault Status word, but does not otherwise affect axis behavior. However, unlike Alarm an explicit Fault Reset is required to clear the fault once the exceptional condition has cleared. Like Ignore and Alarm, if the exception is so fundamental to the drive, Fault Status Only will not be an available option.
Stop Planner	The controller sets the associated bit in the Motion Fault Status word and instructs the Motion Planner to perform a controlled stop of all planned motion at the configured maximum deceleration rate. An explicit Fault Reset is required to clear the fault once the exceptional condition has cleared. If the exception is so fundamental to the drive, Stop Planner will not be an available option.
Stop Drive	When the exception occurs, the associated bit in the Fault Status word is set and the axis will come to a stop by using the stopping action defined by the drive for the particular exception that occurred. There is no controller based configuration to specify what the stopping action is, the stopping action is device dependant.
Shutdown	When the exception occurs, the drive brings the motor to a stop by using the stopping action defined by the drive (as in Stop Drive) and the power module is disabled. An explicit Shutdown Reset is required to restore the drive to operation.

Only selected drive exceptions are configurable. In the fault behavior tables, the controlling attribute is given for programmable fault actions.

Figure 55 - Logix Designer Axis Properties - Actions Category



This dialog box applies to Kinetix 5500 (EtherNet/IP network) servo drives.

Table 55 - Drive Behavior, FLT S*xx* Fault Codes

Exception Fault Code	Exception Text	Permanent Magnet Motor	Induction Motor	Fault Action				Best Available Stopping Action (applies to major faults)
				Ignore	Alarm	Minor Fault	Major Fault	
FLT S03 – MTR OVERSPEED FL	Motor Overspeed Factory Limit Fault	X					X	Coast/Disable
FLT S05 – MTR OVERTEMP FL	Motor Overtemperature Factory Limit Fault	X					X	Coast/Disable
FLT S07 – MTR OVERLOAD FL	Motor Thermal Overload Factory Limit Fault	X	X				X	Decel/Disable
FLT S08 – MTR OVERLOAD UL	Motor Thermal OverLoad User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S10 – INV OVERCURRENT	Inverter Overcurrent Fault	X	X				X	Coast/Disable
FLT S11 – INV OVERTEMP FL	Inverter Overtemperature Factory Limit Fault	X	X				X	Coast/Disable
FLT S13 – INV OVERLOAD FL	Inverter Thermal Overload Factory Limit Fault	X	X				X	Coast/Disable
FLT S14 – INV OVERLOAD UL	Inverter Thermal Overload User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S16 – GROUND CURRENT	Ground Current Factory Limit Fault	X	X				X	Coast/Disable
FLT S18 – CONV OVERTEMP FL	Converter OverTemp Factory Limit Fault	X	X				X	Coast/Disable
FLT S20 – CONV OVERLOAD FL	Converter Thermal OverLoad Factory Limit Fault	X	X				X	Coast/Disable

Table 55 - Drive Behavior, FLT S*xx* Fault Codes (continued)

Exception Fault Code	Exception Text	Permanent Magnet Motor	Induction Motor	Fault Action				Best Available Stopping Action (applies to major faults)
				Ignore	Alarm	Minor Fault	Major Fault	
FLT S21 – CONV OVERLOAD UL	Converter Thermal Overload User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S23 – AC PHASE LOSS	AC Single Phase Loss Fault	X	X	X	X	X	X	Coast/Disable
FLT S25 – PRECHARGE FAILURE	Pre-charge Failure Fault	X	X				X	Coast/Disable
FLT S29 – BUS OVERLOAD FL	Bus Regulator Thermal OverLoad Factory Limit Fault	X	X				X	Coast/Disable
FLT S30 – BUS OVERLOAD UL	Bus Regulator Thermal Overload User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S31 – BUS REGULATOR	Bus Regulator Fault	X	X	X	X	X	X	Coast/Disable
FLT S33 – BUS UNDERVOLT FL	Bus Undervoltage Factory Limit Fault	X	X	X	X	X	X	Decel/Disable
FLT S34 – BUS UNDERVOLT UL	Bus Undervoltage User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S35 – BUS OVERVOLT FL	Bus Overvoltage Factory Limit Fault	X	X				X	Coast/Disable
FLT S39 – BUS POWER	Bus Power Leakage Fault	X	X				X	Coast/Disable
FLT S45 – MTR FDBK COMM FL	Motor Feedback Data Loss Factory Limit Fault	X		X	X	X	X	Coast/Disable
FLT S47 – FDBK DEVICE FAILURE	Feedback Device Failure	X					X	Coast/Disable
FLT S54 – POSN ERROR	Excessive Position Error Fault	X		X	X	X	X	Coast/Disable
FLT S55 – VEL ERROR	Excessive Velocity Error Fault	X		X	X	X	X	Coast/Disable
FLT S56 – OVERTORQUE LIMIT	Overtorque Limit Fault	X		X	X	X	X	Decel/Hold
FLT S57 – UNDERTORQUE LIMIT	Undertorque Limit Fault	X		X	X	X	X	Decel/Hold

Table 56 - Drive Behavior, FLT M*xx* Fault Codes

Exception Fault Code	Exception Text	Permanent Magnet Motor	Induction Motor	Fault Action				Best Available Stopping Action (applies to major faults)
				Ignore	Alarm	Minor Fault	Major Fault	
FLT M02 – MOTOR VOLTAGE	Motor Voltage Mismatch Fault	X		X	X	X	X	Coast/Disable
FLT M14 – CURR FDBK OFFSET	Excessive Current Feedback Offset Fault	X	X				X	Coast/Disable
FLT M25 – COMMON BUS	DC Common Bus Fault	X	X				X	Coast/Disable
FLT M26 – RUNTIME ERROR	Runtime Error	X	X				X	Coast/Disable

Table 57 - Drive Behavior, NODE FLT Fault Codes

Exception Fault Code	Exception Text	Permanent Magnet Motor	Induction Motor	Fault Action				Best Available Stopping Action (applies to major faults)
				Ignore	Alarm	Minor Fault	Major Fault	
NODE FLT 01 – LATE CTRL UPDATE	Control Connection Update Fault	X	X				X	Decel/Disable
NODE FLT 02 – PROC WATCHDOG	Processor Watchdog Fault	X	X				X	Coast/Disable
NODE FLT 03 – HARDWARE	Hardware Fault	X	X				X	Coast/Disable
NODE FLT 06 – LOST CTRL CONN	Lost Controller Connection Fault	X	X				X	Decel/Disable
NODE FLT 07 – CLOCK SYNC	Clock Sync Fault	X	X				X	Coast/Disable
NODE FLT 09 – DUPLICATE IP ADDRESS	Duplicate IP Address Fault	X	X				X	Coast/Disable

Notes:

Removing and Replacing Servo Drives

This chapter provides remove and replace procedures for Kinetix 5500 drives.

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Start and Configure the Drive	130

ATTENTION: This drive contains electrostatic discharge (ESD) sensitive parts and assemblies. You are required to follow static-control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Guarding Against Electrostatic Damage, publication 8000-4.5.2, or any other applicable ESD awareness handbook.

Before You Begin

When each drive is installed, network settings are configured from the setup screens. Before removing the drive, revisit the Network menu and make note of the static IP or DHCP settings. Refer to Configure the Drive on page 88 to access those settings.

IMPORTANT If you intend to use the same Logix Designer application after replacing your drive, the new drive must be the same catalog number as the old drive.

You also need these tools available before you begin removal and replacement procedures:

- Screwdrivers (to loosen/remove screws)
- Voltmeter (to make sure no voltage exists on drive connectors)

Remove and Replace Kinetix 5500 Servo Drives

Follow these steps to remove and replace servo drives from the panel.

Remove Power and All Connections

1. Verify that all control and input power has been removed from the system.

> **ATTENTION:** To avoid shock hazard or personal injury, assure that all power has been removed before proceeding. This system may have multiple sources of power. More than one disconnect switch may be required to de-energize the system.

2. Wait five minutes for the DC bus to discharge completely before proceeding.

> **SHOCK HAZARD:** This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove this unit. You should only attempt the procedures in this document if you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

3. Label and remove all wiring connectors from the drive you are removing.

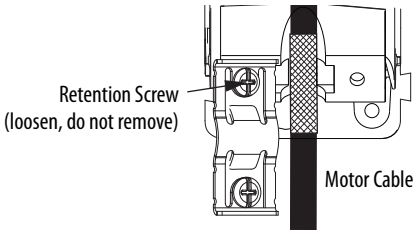
   To identify each connector, refer to Kinetix 5500 Connector Data on page 52.

   TIP You do not need to remove the shunt (RC) connector, unless there is an external shunt wired to it.

4. Remove the shared-bus input wiring connectors, T connectors, and bus-bars from the drive you are removing.

   Refer to Shared-bus Connection System on page 41.

5. Use a screwdriver to loosen the two cable clamp screws, removing the one on the right.



6. Remove the single motor cable from the cable shield clamp.
7. Remove the ground screw and braided ground strap.

   Refer to Ground the System Subpanel on page 67.

Remove the Servo Drive

You can remove single-axis drives from the panel or any single drive from a multi-axis configuration using the same procedure.

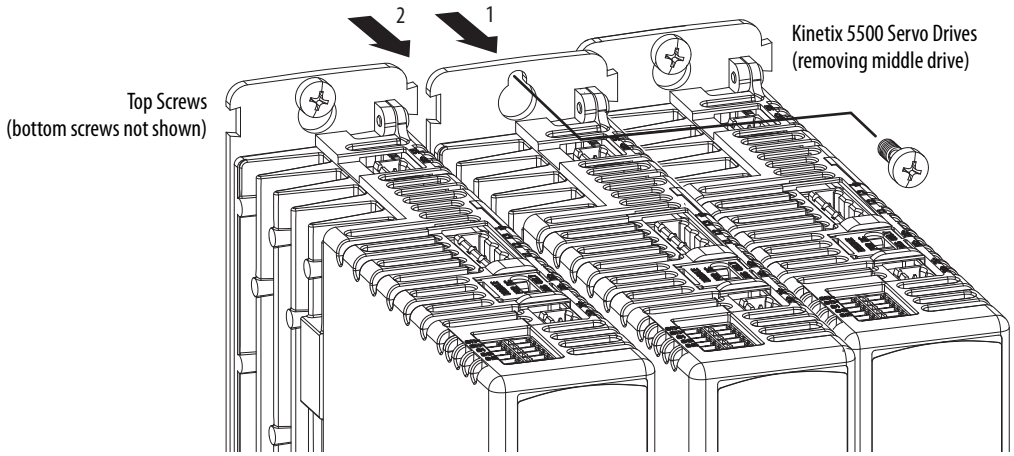
IMPORTANT This procedure applies to any 2198-H*xxx*-ERS drive in any configuration.

Follow these steps to remove Kinetix 5500 servo drives from the panel.

1. Remove the top and bottom screws of the drive to remove.

   Frame 1 and 2 drives have one top and bottom screw. Frame 3 drives have two top and bottom screws.

2. Grasp the top and bottom of the drive with both hands and pull the drive straight out and away from the panel, clearing the zero-stack mounting tabs and cutouts.



Replace the Servo Drive

To replace the servo drive, reverse the steps shown above or refer to Mount Your Kinetix 5500 Drive on page 50:

- Torque mounting, shield clamp, and ground screws to 2.0 N•m (17.7 lb•in) max.
- Reconnect the feedback connector kit and torque the mounting screws to 0.4 N•m (3.5 lb•in) max.

Start and Configure the Drive

Follow these steps to configure the replacement drive.

IMPORTANT	If you intend to use the same Logix Designer application after replacing your drive, the new drive must be the same catalog number as the old drive.

1. Reapply power to the drive/system.

   Refer to Apply Power to the Kinetix 5500 Drive on page 104 for the procedure.

2. Configure the network settings for the drive.

   For example, if your old drive was configured as Static IP, you need to set the IP address, gateway, and subnet mask in the new drive identical to the old drive.

   Refer to Configure the Drive on page 88 to access those settings.

3. Download the Logix Designer application to the controller.
4. Verify the drive/system is working properly.

Kinetix 5500 Safe Torque-off Feature

This appendix introduces you to how the safe torque-off feature meets the requirements of Performance Level d (PLd) and safety category 3 (CAT 3) per EN ISO 13849-1 and SIL 2 per IEC EN 61508, EN 61800-5-2 and EN 62061.

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PFD, PFH, and MTTFd Data	136
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Certification

The TÜV Rheinland group has approved the Kinetix 5500 servo drives for use in safety-related applications up to ISO 13849-1 Performance Level d (PLd) and category 3, SIL 2 per IEC EN 61508, EN 61800-5-2 and EN 62061, in which removing the motion producing power is considered to be the safe state.

To view the certificate, refer to EC Type - Examination Certificate on page 177.

Important Safety Considerations

The system user is responsible for the following:

- Validation of any sensors or actuators connected to the system
- Completing a machine-level risk assessment
- Certification of the machine to the desired EN ISO 13849-1 performance level or EN 62061 SIL level
- Project management and proof testing

Category 3 Requirements According to ISO 13849-1

Safety-related parts are designed with these attributes:

- A single fault in any of these parts does not lead to the loss of the safety function.
- A single fault is detected whenever reasonably practicable.
- Accumulation of undetected faults can lead to the loss of the safety function, which results in failure to remove motion producing power from the motor.

Stop Category Definition

Stop category 0 as defined in EN 60204 or Safe Torque Off as defined by EN 61800-5-2 is achieved with immediate removal of motion producing power to the actuator.

IMPORTANT In the event of a malfunction, the most likely stop category is category 0. When designing the machine application, timing and distance should be considered for a coast to stop. For more information regarding stop categories, refer to EN 60204-1.

Performance Level (PL) and Safety Integrity Level (SIL)

For safety-related control systems, Performance Level (PL), according to EN ISO 13849-1, and SIL levels, according to EN 61508 and EN 62061, include a rating of the systems ability to perform its safety functions. All of the safety-related components of the control system must be included in both a risk assessment and the determination of the achieved levels.

Refer to the EN ISO 13849-1, EN 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination.

European Union Directives

If this product is installed within the European Union or EEC regions and has the CE mark, the following regulations apply.

CE Conformity

Conformity with the Low Voltage Directive and Electromagnetic Compatibility (EMC) Directive is demonstrated by using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. The safe torque-off circuit complies with the EN standards when installed according instructions found in this manual.

EMC Directive

This unit is tested to meet Council Directive 2004/108/EC Electromagnetic Compatibility (EMC) by using these standards, in whole or in part:

- EN 61800-3 - Adjustable Speed Electrical Power Drive Systems, Part 3 - EMC Product Standard including specific test methods
- EN 61326-2-1 EMC - Immunity requirements for safety-related systems

The product described in this manual is intended for use in an industrial environment.

CE Declarations of Conformity are available online at http://www.rockwellautomation.com/products/certification/ce and in EC Declaration of Conformity on page 178.

Low Voltage Directive

These units are tested to meet Council Directive 2006/95/EC Low Voltage Directive. The EN 60204-1 Safety of Machinery-Electrical Equipment of Machines, Part 1-Specification for General Requirements standard applies in whole or in part. Additionally, the standard EN 50178 Electronic Equipment for use in Power Installations apply in whole or in part.

Refer to the Kinetix Servo Drives Specifications Technical Data, publication GMC-TD003, for environmental and mechanical specifications.

Description of Operation

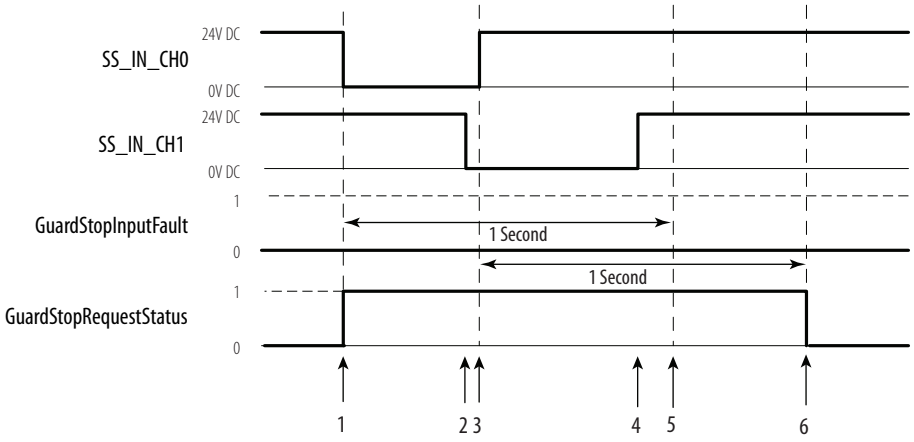
The safe torque-off feature provides a method, with sufficiently low probability of failure, to force the power-transistor control signals to a disabled state. When disabled, or any time power is removed from the safety enable inputs, all of the drive output-power transistors are released from the On-state. This results in a condition where the drive is coasting (stop category 0). Disabling the power transistor output does not provide mechanical isolation of the electrical output, which may be required for some applications.

Under normal operation, the safe torque-off inputs are energized. If either of the safety enable inputs are de-energized, then all of the output power transistors will turn off. The safe torque-off response time is less then 12 ms.

ATTENTION: Permanent magnet motors may, in the event of two simultaneous faults in the IGBT circuit, result in a rotation of up to 180 electrical degrees.

ATTENTION: If any of the safety enable inputs de-energize, the Start Inhibit field indicates SafeTorqueOffInhibit and GuardStopRequestStatus bit of AxisGuardStatus tag set to 1. Both inputs should de-energized within 1 second and re-energized within 1 second to avoid GuardStopInputFault conditions.

Figure 56 - System Operation when Inputs are Meeting Timing Requirements



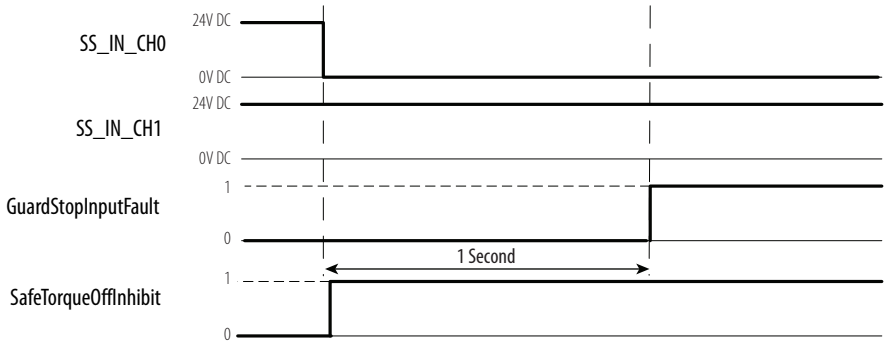
Event	Description
1	At least one input is switched-off. GuardStopRequestStatus bit is set to 1.
2	Second input is switched-off within 1 second. This event should always occur prior to event 3 to prevent GuardStopInputFault.
3	First input is switched-on.
4	Second input is switched-on within 1 second of event 3.
5	Both inputs are in OFF state simultaneously within 1 second. As a result, GuardStopInputFault is not posted.
6	GuardStopRequestStatus bit sets back to 0 if event 4 occurred within 1 second interval after event 3.

Troubleshoot the Safe Torque-off Function

Fault Message Logix Designer	Anomaly	Potential Cause	Possible Resolution
GuardStopInputFault	Safe torque-off function mismatch. System will not allow motion. Safe torque-off mismatch is detected when safety inputs are in a different state for more than 1 second.	• Loose wiring at safe torque-off connector. • Miswiring of the safe torque-off connector. • Cable/header not seated properly in safe torque-off connector.	• Verify wire terminations, cable/header connections, and +24V. • Reset error and run proof test. • If error persists, return the drive to Rockwell Automation.

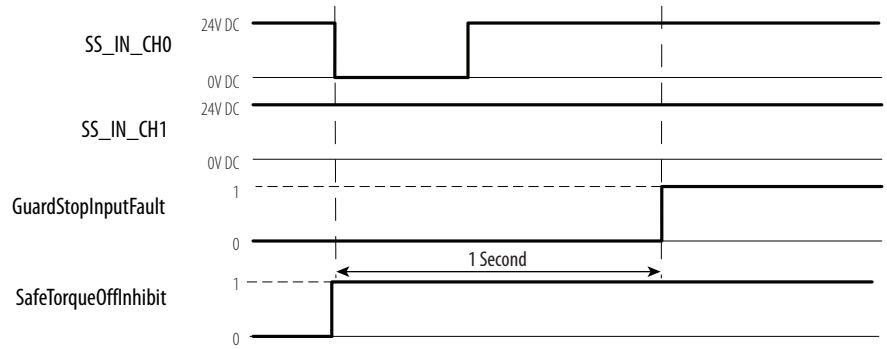
Figure 57 demonstrates when the safe torque-off mismatch is detected and a GuardGateDriveFault is posted.

Figure 57 - System Operation in the Event that the Safety Enable Inputs Mismatch



When one safety input is turned off, the second input must also be turned off, otherwise a fault is asserted (see Figure 58). The fault is asserted even if the first safety input is turned on again.

Figure 58 - System Operation in the Event that the Safety Enable Inputs Mismatch Momentarily



ATTENTION: The safe torque-off fault is detected upon demand of the safe torque-off function. After troubleshooting, a safety function must be executed to verify correct operation.

IMPORTANT The Safe Torque Off fault can be reset only if both inputs are in the Off-state for more than 1 second. After the fault reset requirement is satisfied, an MASR command in the Logix Designer application should be issued to reset the GuardGateDriveFault.

PFD, PFH, and MTTFd Definitions

Safety-related systems can be classified as operating in either a Low Demand mode, or in a High Demand/Continuous mode:

- Low Demand mode: where the frequency of demands for operation made on a safety-related system is no greater than one per year or no greater than twice the proof-test frequency.
- High Demand/Continuous mode: where the frequency of demands for operation made on a safety-related system is greater than once per year.

The SIL value for a low demand safety-related system is directly related to order-of-magnitude ranges of its average probability of failure to satisfactorily perform its safety function on demand or, simply, average probability of failure on demand (PFD). The SIL value for a High Demand/Continuous mode safety-related system is directly related to the probability of a dangerous failure occurring per hour (PFH).

PFD, PFH, and MTTFd Data

These PFD and PFH calculations are based on the equations from EN 61508 and show worst-case values.

This table provides data for a 20-year proof test interval and demonstrates the worst-case effect of various configuration changes on the data.

Determination of safety parameters is based on the assumption that the system operates in high demand mode and that the safety function will be requested at least once a year.

Table 58 - PFD and PFH for 20-year Proof Test Interval

Attribute	Value
PFH (1e-9)	0.35
PFD (1e-3)	0.061
Proof test (years)	20

Safe Torque-off Connector Data

Two rows of five pins are provided for making drive-to-drive connections in multi-axis configurations.

Figure 59 - Pin Orientation for 5-pin Safe Torque-off (STO) Connector

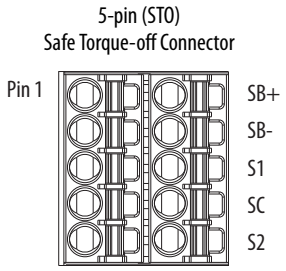


Table 59 - Safe Torque-off Connector Pinouts

STO Pin	Description	Signal
1	Safety bypass plus signal. Connect to both safety inputs to disable safe torque-off function.	SB+
2	Safety bypass minus signal. Connect to safety common to disable safe torque-off function.	SB-
3	Safe stop input channel 1 (SS_IN_CH0).	S1
4	Safe stop input common (SCOM).	SC
5	Safe stop input channel 2 (SS_IN_CH1).	S2

Wire the Safe Torque-off Circuit

This section provides guidelines for wiring your Kinetix 5500 safe torque-off drive connections.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in Establishing Noise Zones beginning on page 33

IMPORTANT Pins 1 and 2 (SB+ and SB-) are used to disable the safe torque-off function. When wiring to the STO connector, the 24V supply (for an external safety device that triggers the safe torque-off request) must come from an external source, otherwise system performance will be jeopardized.

Safe Torque-off Wiring Requirements

The safe torque-off (STO) connector uses spring tension to secure the wire. Depress the tab, along side each pin, to release the wire. Two rows of pins are provided for drive-to-drive connections. Wire should be copper with 75 °C (167 °F) minimum rating.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

IMPORTANT Stranded wires must terminate with ferrules to prevent short circuits, per table D7 of EN 13849.

Figure 60 - Safe Torque-off (STO) Terminal Plug

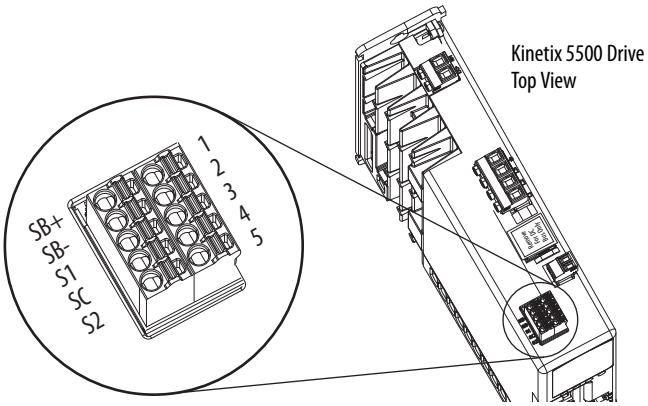


Table 60 - Safe Torque-off (STO) Terminal Plug Wiring

Safe Torque-off (STO) Connector		Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value N•m (lb•in)
Pin	**Signal**			
STO-1 STO-2 STO-3 STO-4 STO-5	SB+ SB- S1 SC S2	16…24	10 (0.25)	N/A

IMPORTANT To improve system performance, run wires and cables in the wireways as established in Establishing Noise Zones beginning on page 33.

Safe Torque-off Feature

The safe torque-off circuit, when used with suitable safety components, provides protection according to ISO 13849-1 (PLd), Cat3 or according to EN 62061 (SIL2). The safe torque-off option is just one safety control system. All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding.

The safe torque-off circuit is designed to safely turn off all of the output-power transistors. You can use the safe torque-off circuit in combination with other safety devices to achieve the stop and protection-against-restart as specified in IEC 60204-1.

ATTENTION: This option may be suitable for performing mechanical work on the drive system or affected area of a machine only. It does not provide electrical safety.

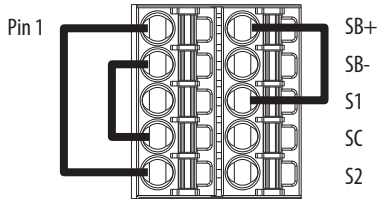
SHOCK HAZARD: In Safe Torque-off mode, hazardous voltages may still be present at the drive. To avoid an electric shock hazard, disconnect power to the system and verify that the voltage is zero before performing any work on the drive.

The Kinetix 5500 drives do not operate without a safety circuit or safety bypass wiring. For applications that do not require the safe torque-off feature you must install jumper wires to bypass the safe torque-off circuitry.

Safe Torque-off Feature Bypass

Each Kinetix 5500 drive ships with two 5-pin wiring plugs for wiring to safety devices. To bypass the safety function, these signals should be wired as shown in Figure 61. With the jumper wires installed, the safe-off feature is not used.

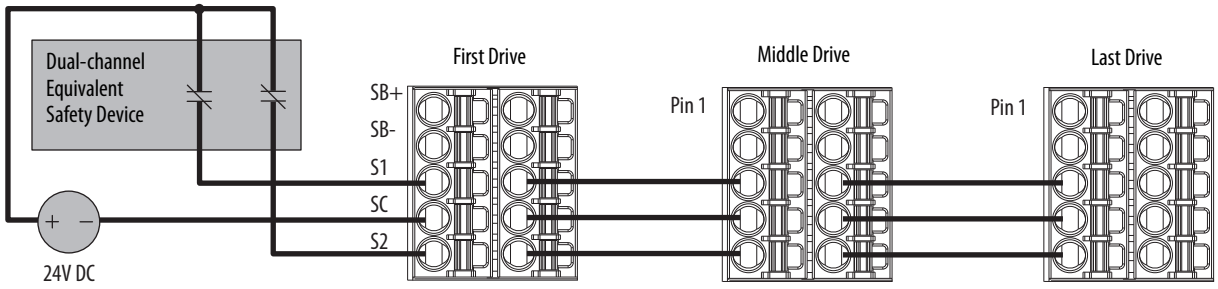
Figure 61 - Safe Torque-off Bypass Wiring



Cascade the Safe Torque-off Signal

The total number of drives in a single cascaded safety circuit is limited due to the current carrying capacity of the cascaded safety wiring. Refer to Table 61 for current rating per channel, per drive.

Figure 62 - Cascaded Safe Torque-off Wiring



Safe Torque-off Specifications

To maintain safety rating, Kinetix 5500 drives must be installed inside protected control panels or cabinets appropriate for the environmental conditions of the industrial location. The protection class of the panel or cabinet should be IP54 or higher.

Table 61 - Safe Torque-off Signal Specifications

Attribute		Value
Safety inputs (per channel)	Input current	< 10 mA
	Input ON voltage range	18…26.4V DC
	Input OFF voltage, max	5V DC
	Input OFF current	2 mA @ V in < 5V DC
	Pulse rejection width	700 µs
	External power supply	SELV/PELV
	Input type	Optically isolated and reverse voltage protected

For additional information regarding Allen-Bradley safety products, including safety relays, light curtain, and gate interlock applications, refer to the Safety Products Catalog, website http://www.ab.com/catalogs.

Interconnect Diagrams

This appendix provides wiring examples and system block diagrams for your Kinetix 5500 system components.

Topic	Page
Interconnect Diagram Notes	141
Power Wiring Examples	142
Bus-sharing Wiring Examples	144
Shunt Resistor Wiring Example	146
Kinetix 5500 Drive/Motor Wiring Example	147
System Block Diagrams	148

Interconnect Diagram Notes

This appendix provides wiring examples to assist you in wiring the Kinetix 5500 drive system. These notes apply to the wiring examples on the following pages.

Note	Information
1	For power wiring specifications, refer to Wiring Requirements on page 69.
2	For input fuse and circuit breaker sizes, refer to Circuit Breaker/Fuse Selection on page 25.
3	AC (EMC) line filter is required for EMC compliance. Place line filter as close to the drive as possible and do not route very dirty wires in wireway. If routing in wireway is unavoidable, use shielded cable with shields grounded to the drive chassis and filter case. For AC line filter specifications, refer to Kinetix Servo Drives Specifications Technical Data, publication GMC-TD003.
4	Terminal block is required to make connections.
5	Cable shield clamp must be used to meet CE requirements.
6	PE ground connection bonded to the panel must be used to meet CE requirements.
7	DC connector covered with protective knockout is default configuration. Remove knockout to insert DC bus T connector and bus-bars. No discrete wiring to DC bus terminals.
8	Internal shunt wired to the RC connector is default configuration. Remove internal shunt wires to attach external shunt wires.
9	Default configuration for ground screws is for grounded power at user site. For ungrounded or corner-grounded power, remove the screws. Refer to Determine the Input Power Configuration on page 63 for more information.
10	**ATTENTION:** Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN 1050 and EN ISO 13849-1 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive, publication SHB-900.
11	For motor cable specifications, refer to Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004.
12	Brake connector pins are labeled plus (+) and minus (-) or F and G respectively. Power connector pins are labeled U, V, W, and ⏚ or A, B, C, and ⏚ respectively.

Power Wiring Examples

You must supply input power components. The single-phase and three-phase line filters are wired downstream of the input fusing.

Single-axis Drive Wiring Examples

Figure 63 - Kinetix 5500 Drives Power Wiring (three-phase operation)

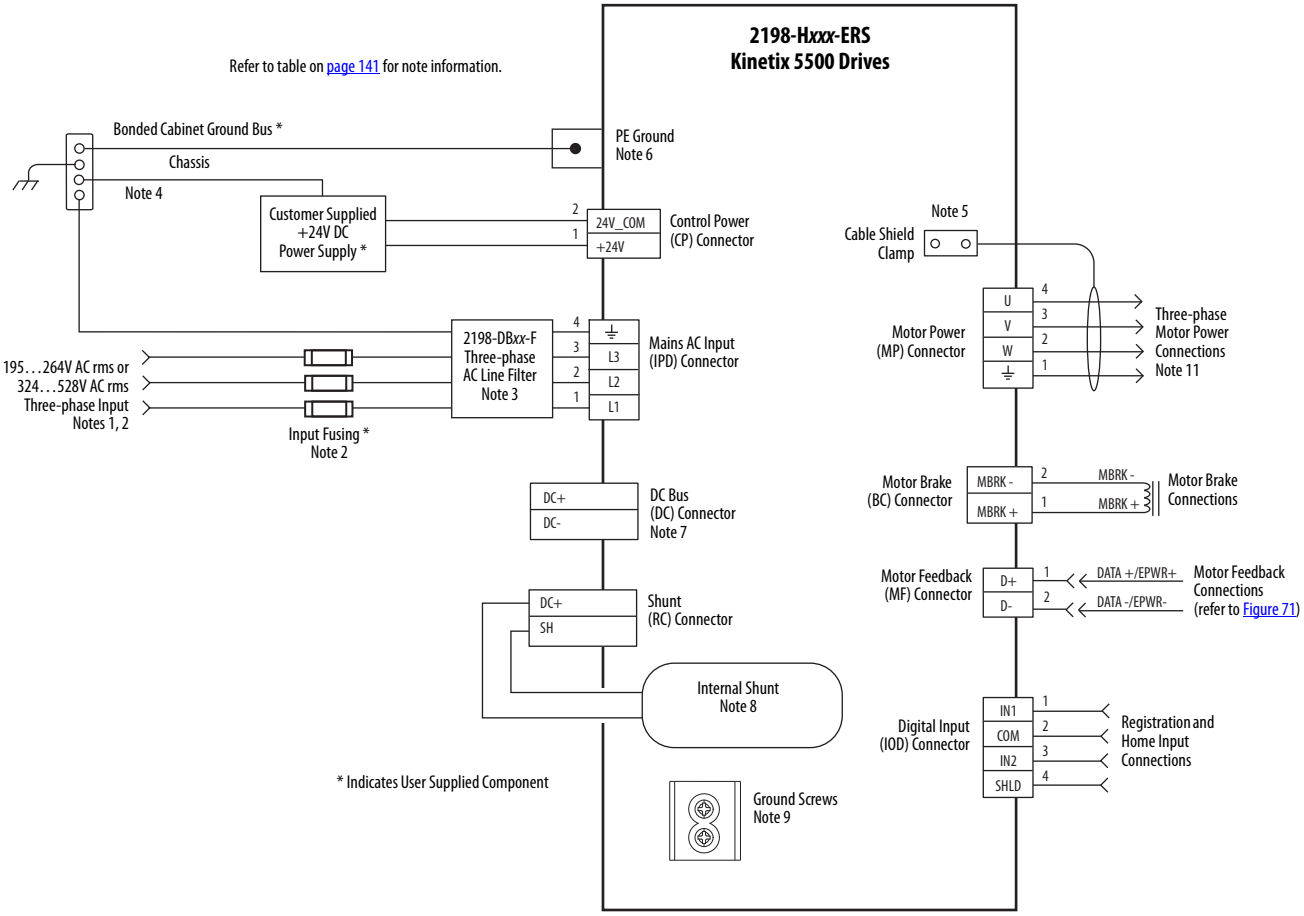


Figure 64 - Kinetix 5500 Drives Power Wiring (single-phase operation)

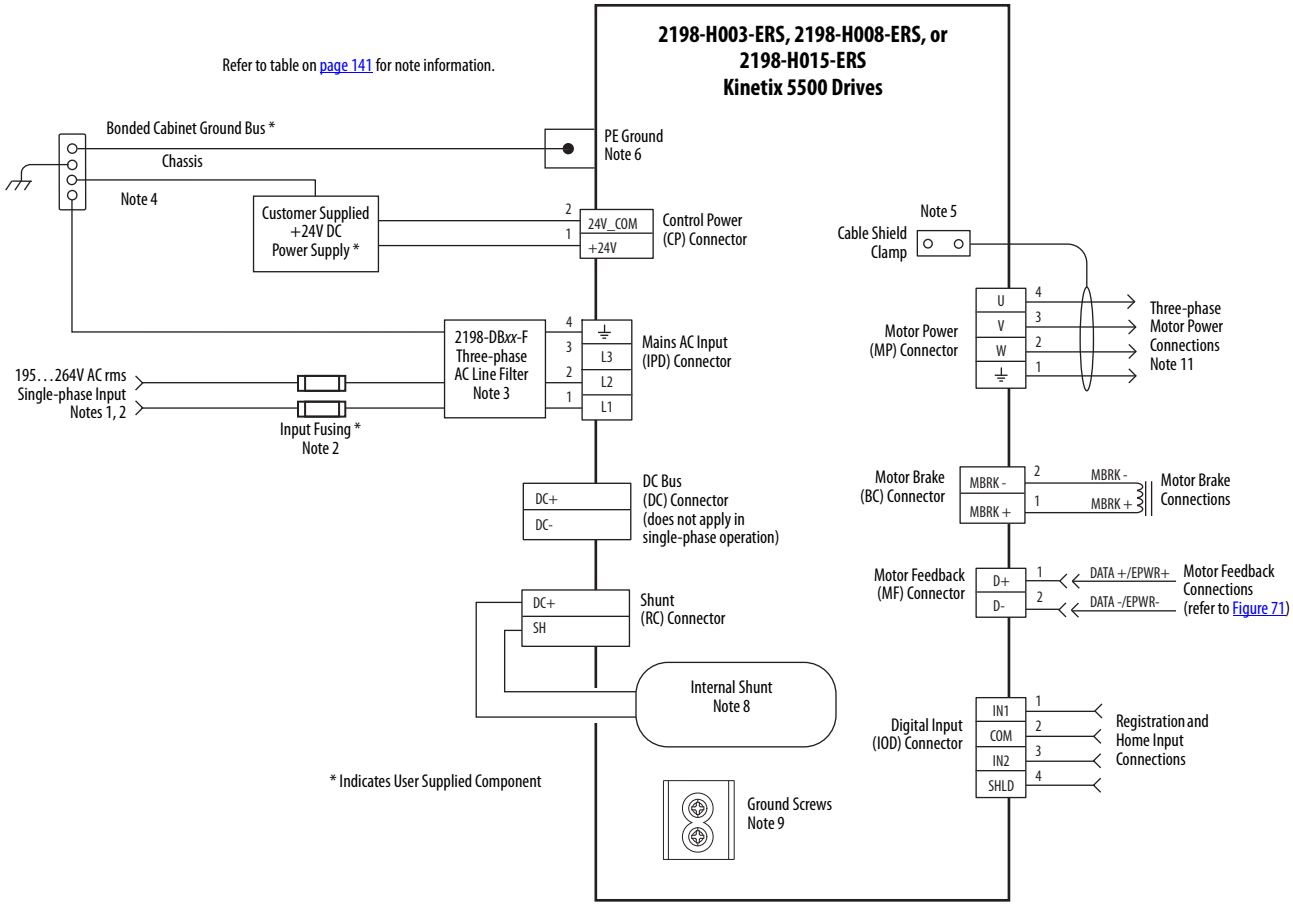
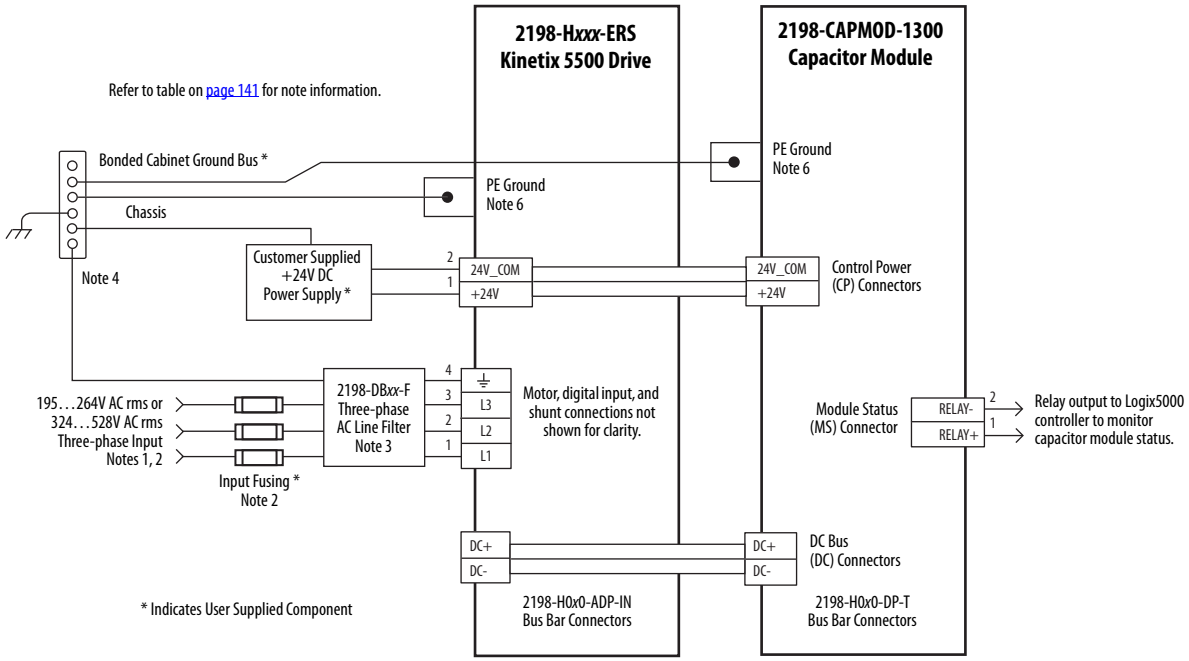


Figure 65 - Kinetix 5500 Capacitor Module



Bus-sharing Wiring Examples

For bus-sharing configurations, use the 2198-H0*x*0-*xx-x* shared-bus connection system to extend power from drive to drive.

Figure 66 - Kinetix 5500 Drives with Shared AC Bus

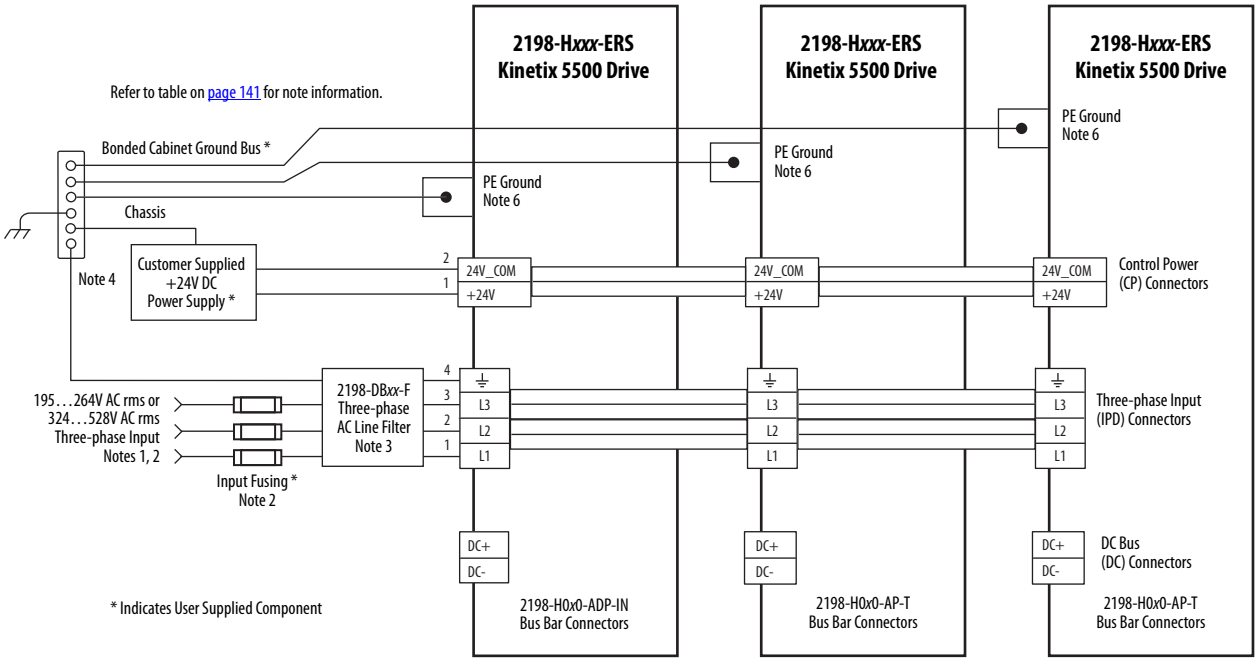


Figure 67 - Kinetix 5500 Drives with Shared AC/DC Bus

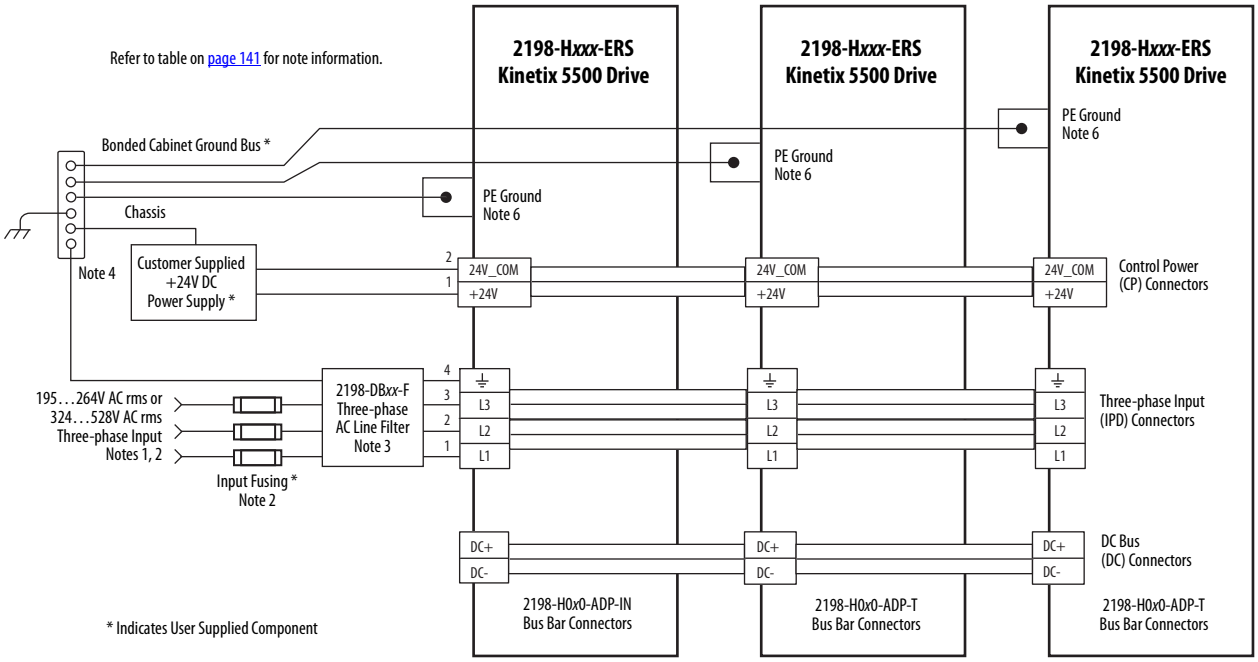


Figure 68 - Kinetix 5500 Drives with Shared DC (common bus)

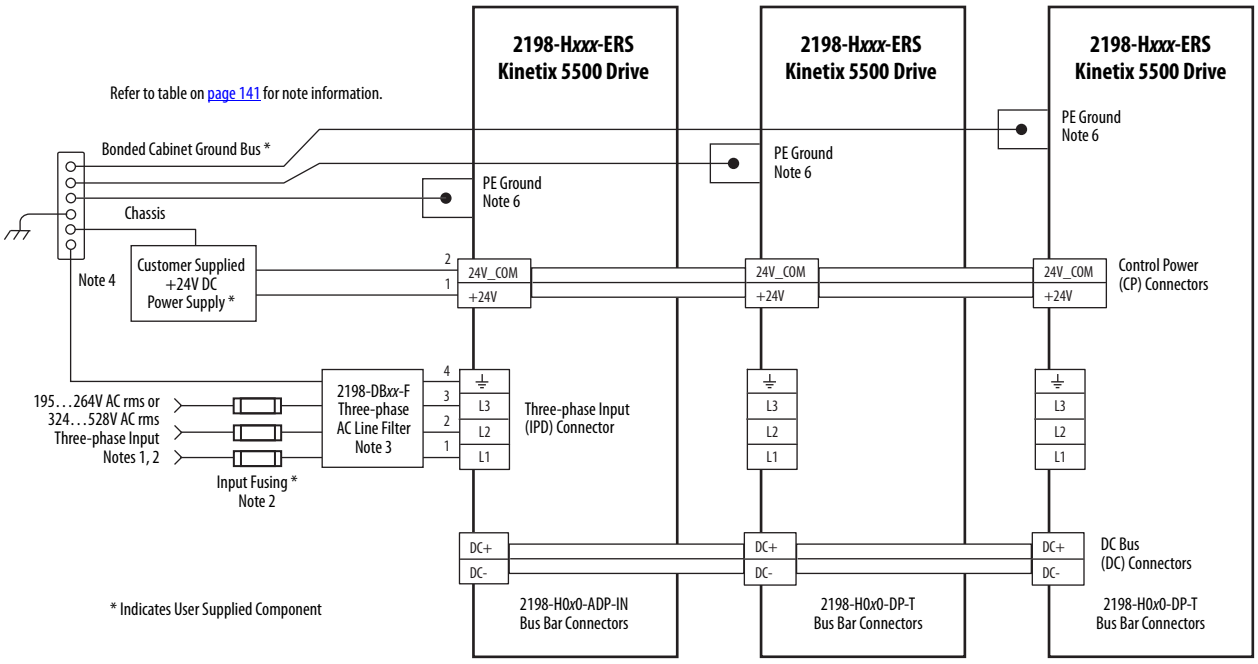
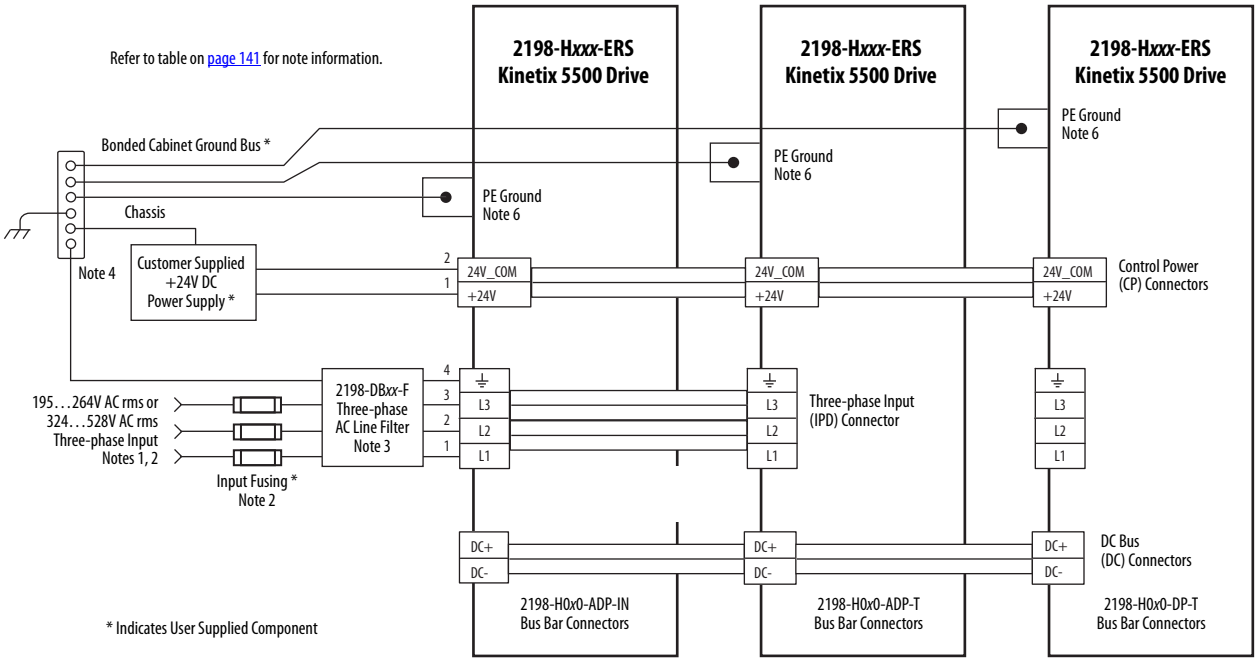


Figure 69 - Kinetix 5500 Drives with Shared AC/DC Hybrid Bus

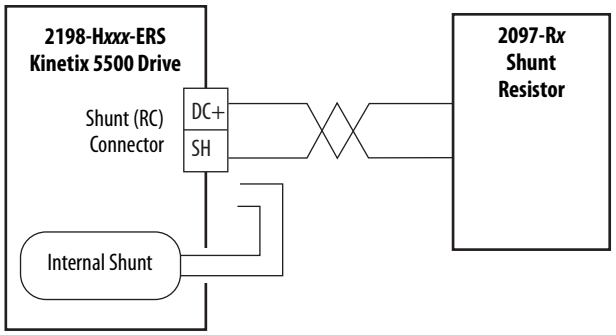


Shunt Resistor Wiring Example

Refer to the External Shunt Resistor Connections on page 80 for the Bulletin 2097 external shunt resistor catalog numbers available for Kinetix 5500 servo drives.

IMPORTANT Before wiring the Bulletin 2097 external shunt to the RC connector, remove the wires from the servo drive internal shunt. Do not connect internal and external shunt resistors to the drive.

Figure 70 - Shunt Resistor Wiring Example



Refer to the Kinetix 300 Shunt Resistor Installation Instructions, publication 2097-IN002, for shunt resistor installation instructions.

Kinetix 5500 Drive/Motor Wiring Example

The Kinetix VP (Bulletin VPL) motors use single-cable technology. The motor power, brake, and feedback wires are all packaged in a single cable.

Figure 71 - Kinetix 5500 Drives with Kinetix VP Motors (Bulletin VPL)

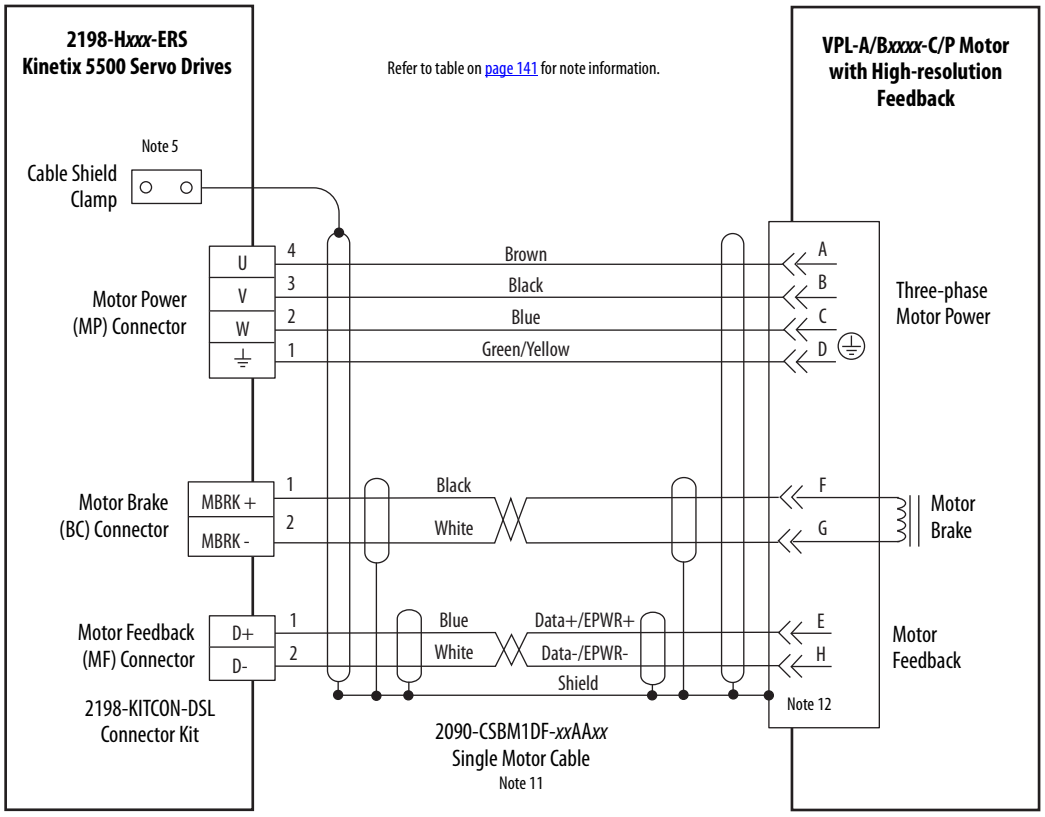
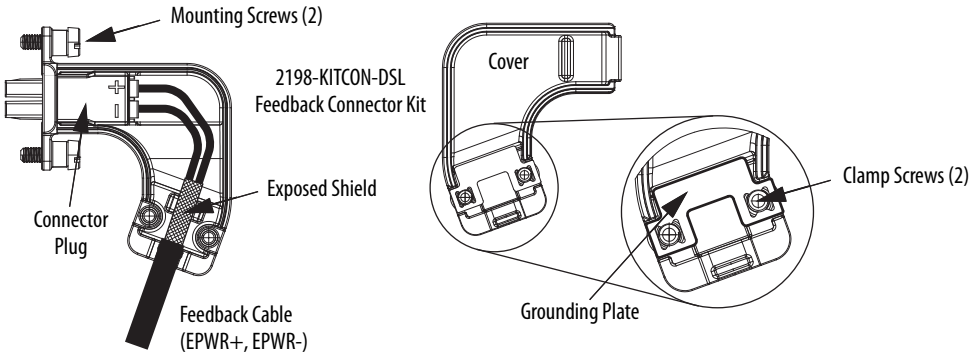


Figure 72 - Grounding Technique for Feedback Cable Shield



Refer to Kinetix 5500 Feedback Connector Kit Installation Instructions, publication 2198-IN002, for connector kit specifications.

System Block Diagrams

This section provides block diagrams of the Kinetix 5500 drive modules.

Figure 73 - Kinetix 5500 Drive Block Diagram

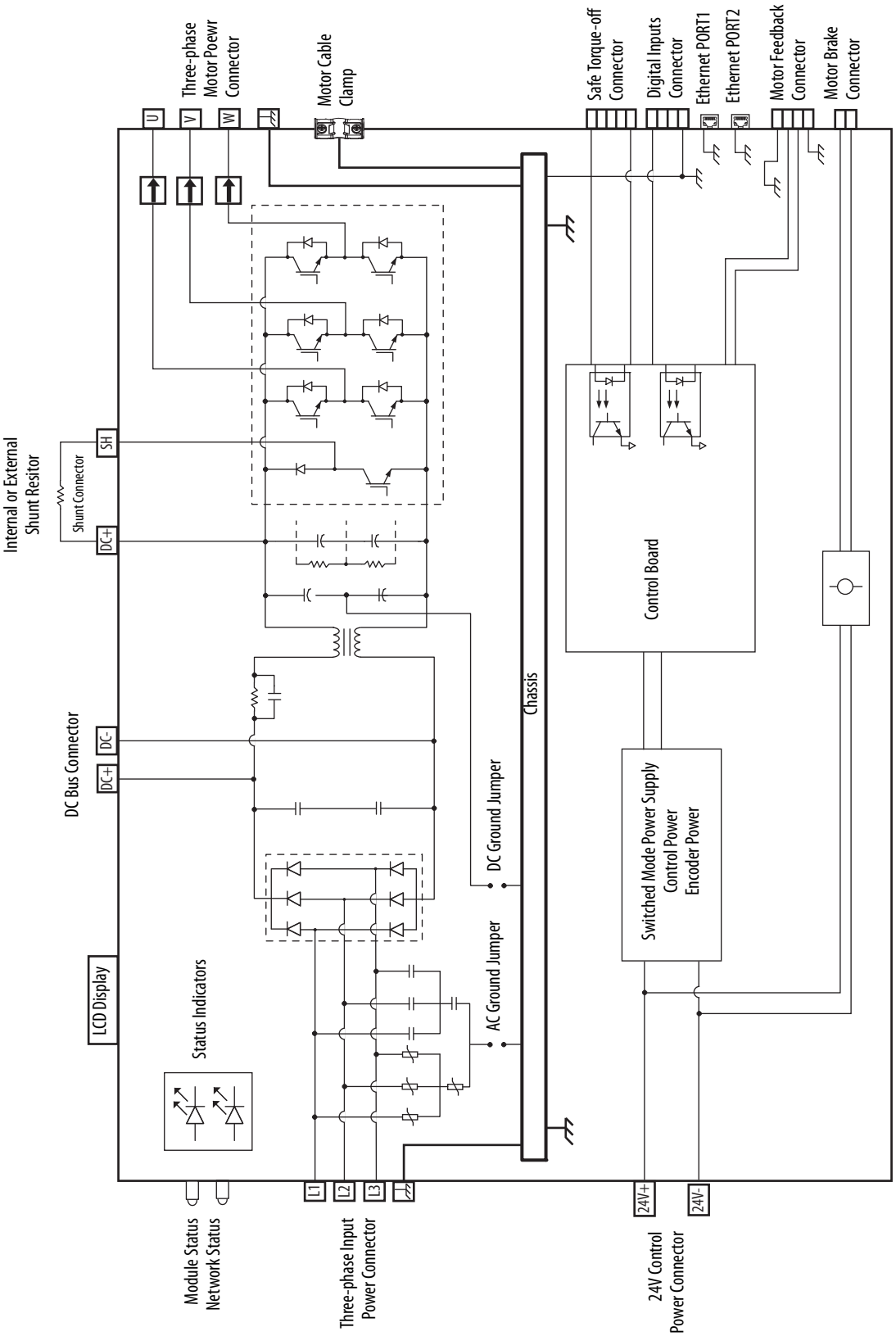
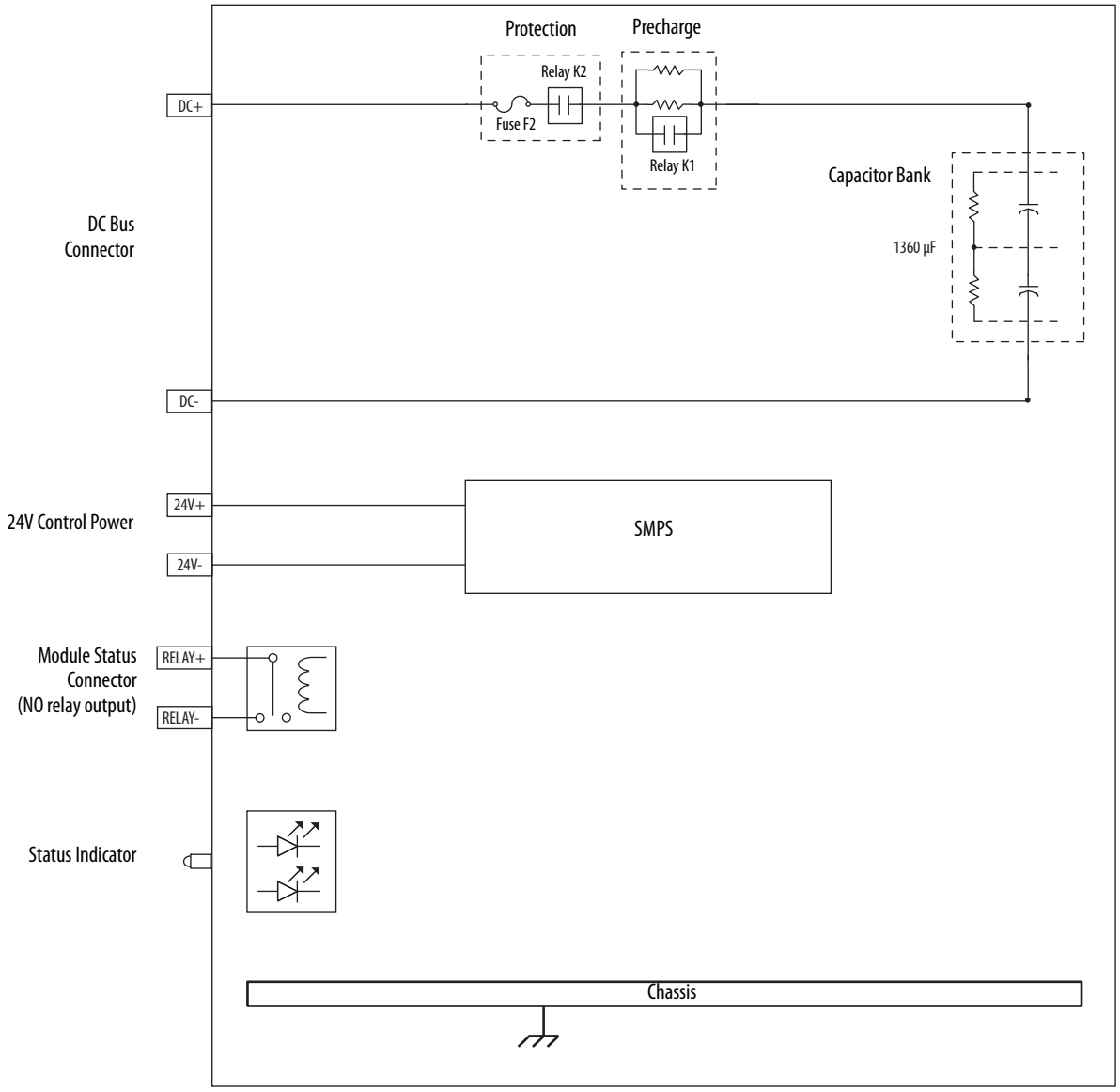


Figure 74 - Kinetix 5500 Capacitor Module Block Diagram



Notes:

Upgrade the Drive Firmware

This appendix provides procedures for upgrading firmware by using ControlFLASH software.

Topic	Page
Before You Begin	152
Upgrade Firmware	155
Verify the Firmware Upgrade	159

Upgrading drive firmware by using ControlFLASH software involves configuring your Logix5000 controller communication, selecting the drive to upgrade, and upgrading the firmware.

IMPORTANT If the drive firmware contains updated safety firmware, you must de-energize the safety inputs first or the upgrade will fail.

In order to update drive firmware in Feedback Only mode, you must inhibit the axis first. Refer to Inhibit Feedback Only Axis on page 154 for more information.

Before You Begin

The firmware revision for software must be as shown for EtherNet/IP networks.

Table 62 - Kinetix 5500 System Requirements

Description	Firmware Revision
Logix Designer application	21.00 or later
RSLinx software	2.58 or later
ControlFLASH software kit (1)	11.00 or later
Catalog numbers of the targeted Kinetix 5500 drive module you want to upgrade.	
Network path to the targeted Kinetix 5500 drive module you want to upgrade.	

(1) Download the ControlFLASH kit from http://support.rockwellautomation.com/controlflash. Contact Rockwell Automation Technical Support at (440) 646-5800 for assistance.

For more ControlFLASH information (not drive specific), refer to the ControlFLASH Firmware Upgrade Kit Quick Start, publication 1756-QS105.

IMPORTANT Control power must be present at CP-1 (24V+) and CP-2 (24V-) prior to upgrading your target drive. The axis state on the LCD display must be STANDBY, CONFIGURING, STOPPED, or PRECHARGE before beginning this procedure.

ATTENTION: To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply three-phase AC or common-bus DC input power to the drive.

Configure Logix5000 Controller Communication

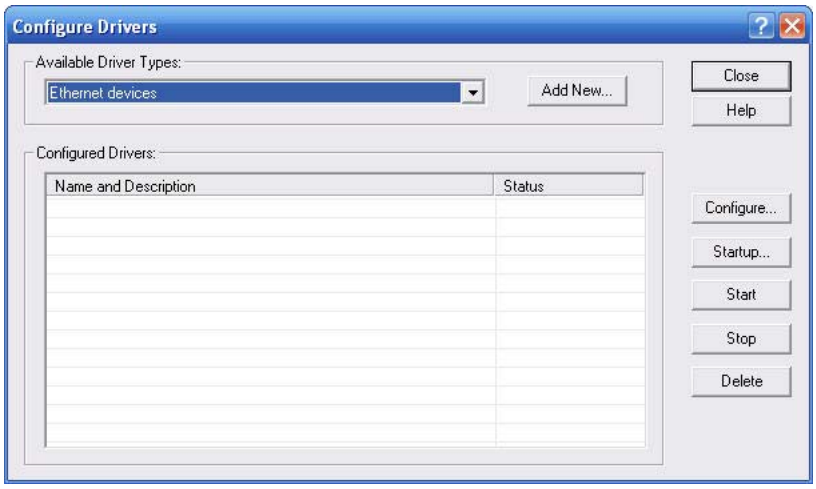
This procedure assumes that your communication method to the Logix5000 controller is the Ethernet network. It is also assumed that your Logix5000 Ethernet module or controller has already been configured.

For more controller information, refer to Additional Resources on page 10.

Follow these steps to configure Logix5000 controller communication.

1. Open your RSLinx Classic software.
2. From the Communications menu, choose Configure Drivers.

   The Configure Drivers dialog box opens.



3. From the Available Driver Types pull-down menu, choose Ethernet devices.
4. Click Add New.

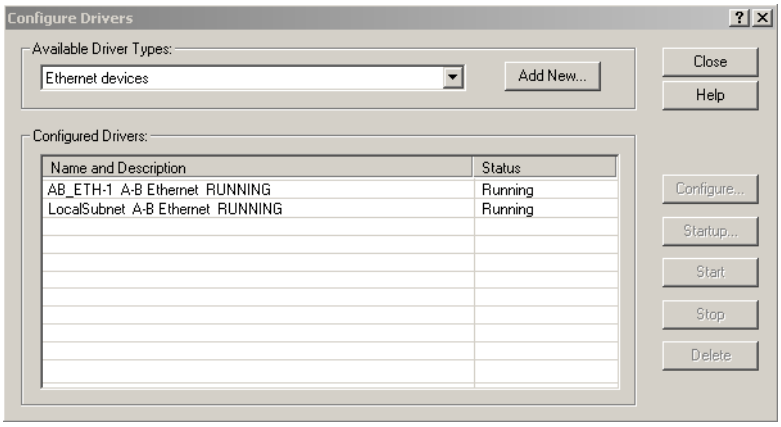
   The Add New RSLinx Classic Driver dialog box opens.
5. Type the new driver name.

6. Click OK.

   The Configure driver dialog box opens.

7. Type the IP address of your Kinetix 5500 servo drive.
8. Click OK.

   The new Ethernet driver appears under Configured Drivers.



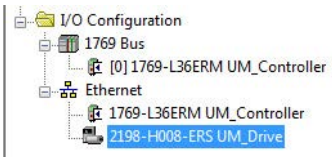
9. Click Close.
10. Minimize the RSLinx application dialog box.

Inhibit Feedback Only Axis

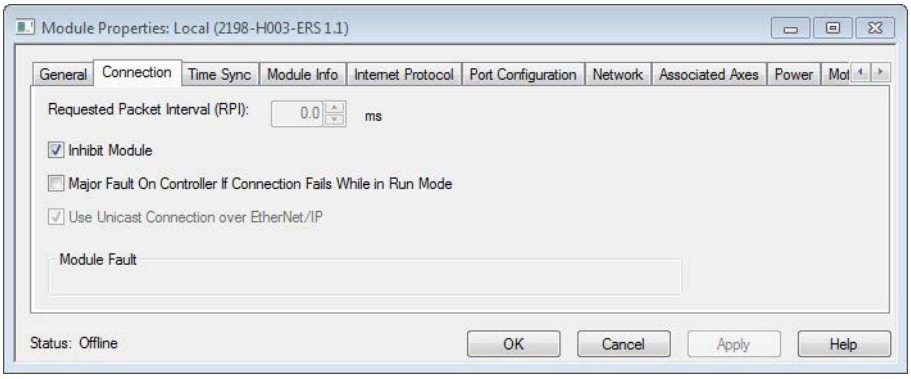
If an axis is configured as Feedback Only, you must inhibit the axis prior to performing the firmware upgrade. Follow these steps to inhibit an axis.

1. Open your Logix Designer application.
2. Right-click the 2198-H*xxx*-ERS servo drive you configured as Feedback Only and choose Properties.

   The Module Properties dialog box opens.



3. Click the Connection tab.



4. Check Inhibit Module.
5. Click OK.
6. Save your file and download the program to the controller.

Upgrade Firmware

Follow these steps to select the drive module to upgrade.

1. In the Logix Designer application, from the Tools menu, choose ControlFLASH.

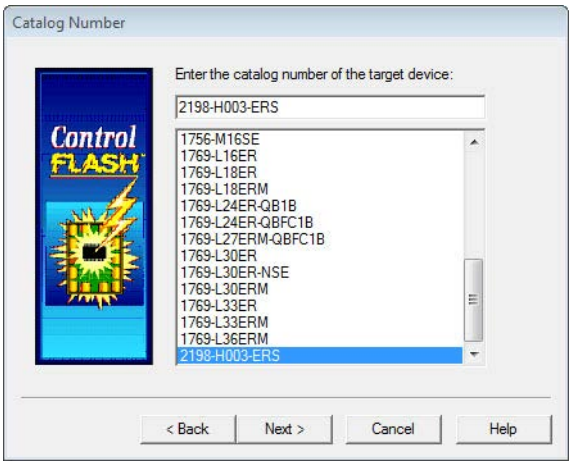
   TIP You can also open ControlFLASH software by choosing Start>Programs>FLASH Programming Tools>ControlFLASH.

   The Welcome to ControlFLASH dialog box opens.

Welcome to ControlFLASH
Welcome to ControlFLASH, the firmware update tool. ControlFLASH needs the following information from you before it can begin updating a device.
1.The Catalog Number of the target device.
2.The Network Configuration parameters (optional).
3.The Network Path to the target device.
4.The Firmware Revision for this update.
View Log
< Back
Next >
Cancel
Help

2. Click Next.

   The Catalog Number dialog box opens.

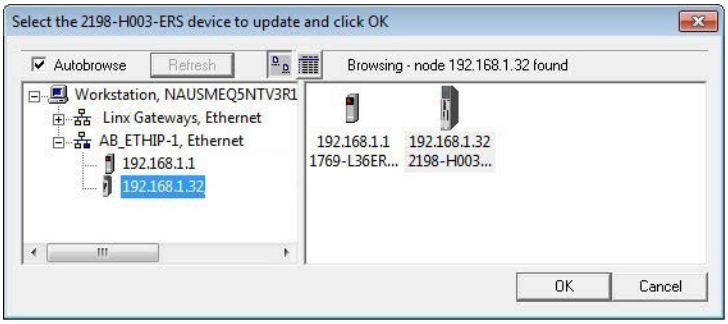


3. Select your drive module.

   In this example, the 2198-H003-ERS servo drive is selected.

4. Click Next.

   The Select Device to Update dialog box opens.

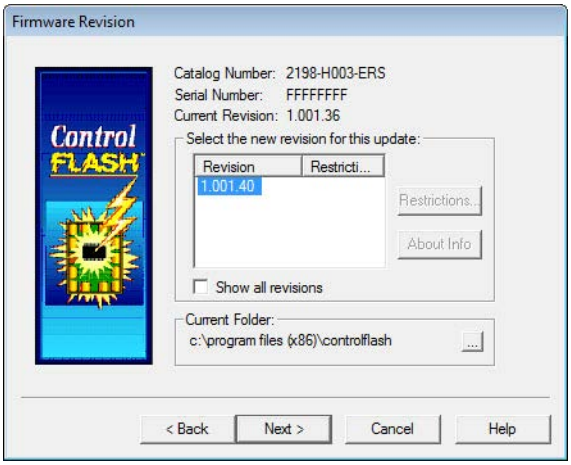


5. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.

6. Select the servo drive to upgrade.

7. Click OK.

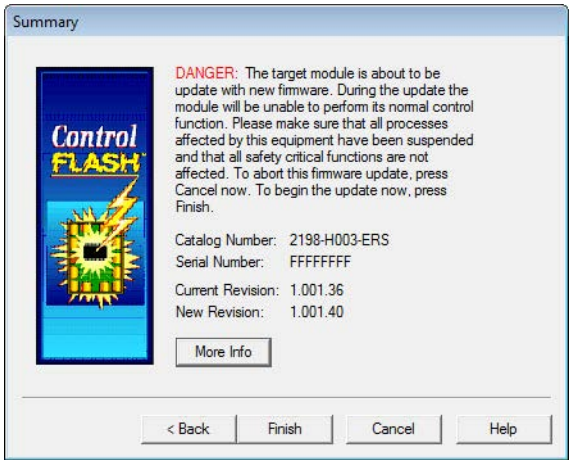
   The Firmware Revision dialog box opens.



8. Select the firmware revision to upgrade.

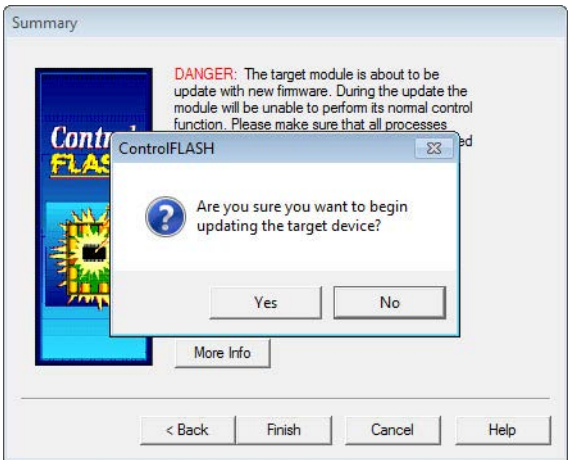
9. Click Next.

The Summary dialog box opens.


Summary
DANGER: The target module is about to be update with new firmware. During the update the module will be unable to perform its normal control function. Please make sure that all processes affected by this equipment have been suspended and that all safety critical functions are not affected. To abort this firmware update, press Cancel now. To begin the update now, press Finish.
Catalog Number: 2198-H003-ERS
Serial Number: FFFFFFFF
Current Revision: 1.001.36
New Revision: 1.001.40
More Info
< Back
Finish
Cancel
Help

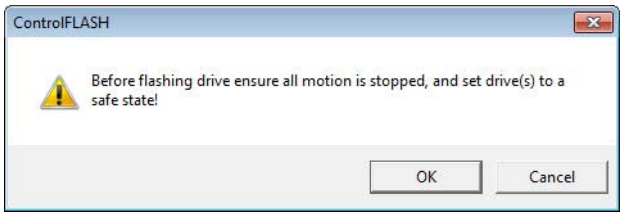
10. Confirm the drive catalog number and firmware revision.
11. Click Finish.

    This ControlFLASH warning dialog box opens.


Summary
DANGER: The target module is about to be update with new firmware. During the update the module will be unable to perform its normal control function. Please make sure that all processes
ControlFLASH
Are you sure you want to begin updating the target device?
Yes
No
More Info
< Back
Finish
Cancel
Help

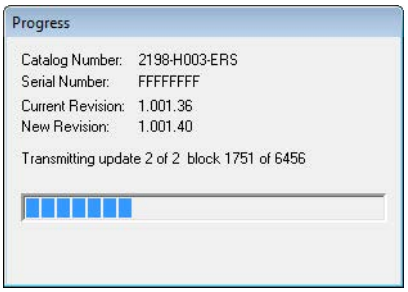
12. Click Yes (only if you are ready).

    This ControlFLASH warning dialog box opens.



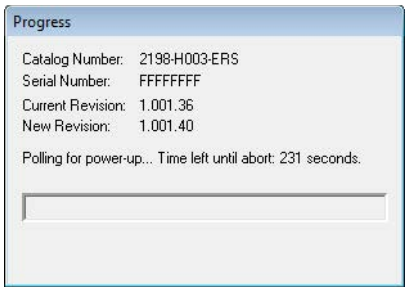
13. Acknowledge the warning and click OK.

The Progress dialog box opens and flashing begins.



The axis state on the LCD display changes from CONFIGURING, STOPPED, or PRECHARGE to FIRMWARE UPDATE, which indicates that the upgrade is in progress.

After the upgrade information is sent to the drive, the drive resets and performs diagnostic checking.



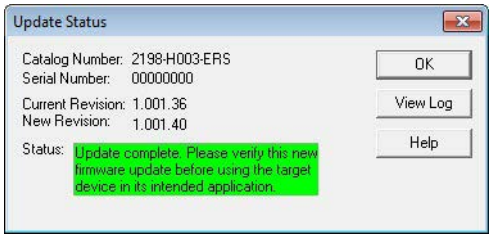
14. Wait for the Progress dialog box to time out.

    It is normal for this process to take several minutes.

IMPORTANT Do not cycle power to the drive during this process or the firmware upgrade will not complete successfully.

15. Verify that the Update Status dialog box opens and indicates success or failure as described below.

Upgrading Status	If
Success	Update complete appears in a GREEN Status dialog box, then go to step 16.
Failure	Update failure appears in a RED Status dialog box, then refer to ControlFLASH Firmware Upgrade Kit Quick Start, publication 1756-QS105, for troubleshooting information.


Update Status
Catalog Number: 2198-H003-ERS
Serial Number: 00000000
Current Revision: 1.001.36
New Revision: 1.001.40
Status: Update complete. Please verify this new firmware update before using the target device in its intended application.
OK
View Log
Help

16. Click OK.

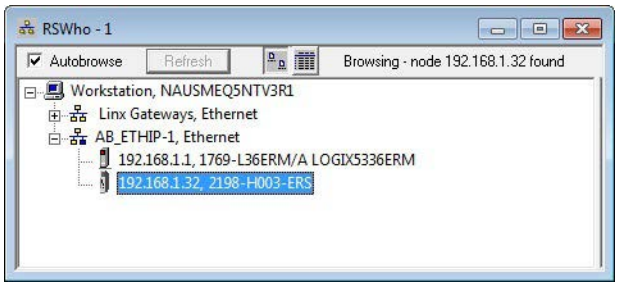
IMPORTANT If you are upgrading a feedback-only axis and you checked Inhibit Module on the Connection tab in Module Properties, you must clear the Inhibit Module checkbox before resuming normal operation.

Verify the Firmware Upgrade

Follow these steps to verify your firmware upgrade was successful.

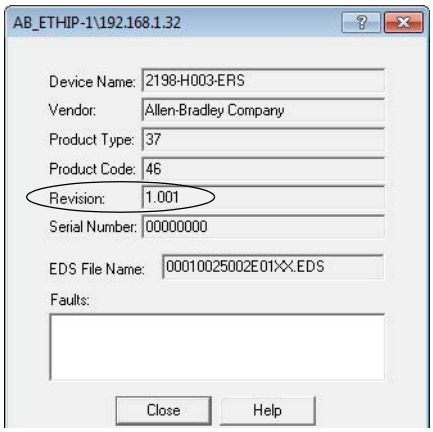
TIP Verifying the firmware upgrade is optional.

1. Open your RSLinx software.
2. From the Communications menu, choose RSWho.



3. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.
4. Right-click the drive module and choose Device Properties.

   The Device Properties dialog box opens.



5. Verify the new firmware revision level.
6. Click Close.

Notes:

Sizing Multi-axis Shared-bus Configurations

This appendix provides information and examples for sizing your Kinetix 5500 drive shared-bus configurations.

Topic	Page
Shared-bus Configurations	161
Power Sharing Sizing Examples	166
Control Power Current Calculations	168
Energy Calculations	170

Shared-bus configurations include the following types:

- Shared AC
- Shared DC (common bus)
- Shared AC/DC
- Shared AC/DC Hybrid

These restrictions apply to all shared-bus configurations:

- Shared-bus configurations must use the shared-bus connection system.

IMPORTANT Do not make drive-to-drive connections with discrete wires.

- Single-phase drive operation is not supported.
- Shared AC/DC and shared AC/DC hybrid configurations result in a derating of 30% of the total converter power available.
- The zero-stack tabs and cutouts must be engaged from drive-to-drive. Systems cannot start in one cabinet and end in another.
- Program drives for the same converter AC input voltage.

Shared-bus Configurations

These restrictions apply to multi-axis shared-bus configurations:

- All drives in a bus-sharing group must be configured with the same bus power-sharing group number in the Logix Designer application.
- The maximum number of drives in any bus power-sharing group cannot exceed eight.

Shared AC Configurations

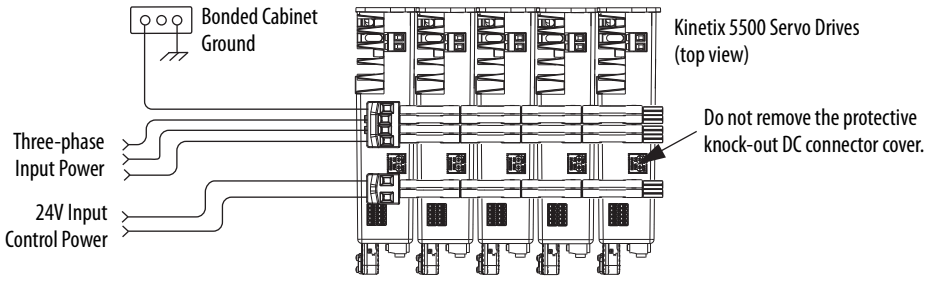
In shared AC configurations, the first (leftmost) drive receives AC input voltage. The shared-bus connection system extends the AC bus to all downstream drives:

- All drives are configured in the project file as Standalone drives.
- Drives configured in the project file as Standalone in a Shared AC configuration must be of the same power rating (catalog number).
- Shared AC configurations do not support Bulletin 2198 capacitor modules.
- The maximum number of drives in Shared AC configurations is restricted as described in Table 63.

Table 63 - Shared AC Panel Layout

Drive Cat. No.	Frame Size	Number of Drives Configured as Shared AC, max
2198-H003-ERS	1	5
2198-H008-ERS		
2198-H015-ERS	2	3
2198-H025-ERS		
2198-H040-ERS		
2198-H070-ERS	3	2

Figure 75 - Typical Shared AC Configuration


Bonded Cabinet Ground
Kinetix 5500 Servo Drives (top view)
Do not remove the protective knock-out DC connector cover.
Three-phase Input Power
24V Input Control Power

For an example shared AC installation with additional details, refer to Typical Shared AC Installations on page 14.

Shared DC Configurations

In a Shared DC (DC common bus) configuration, the first (leftmost) drive is the leader drive and is the only drive that receives the AC input voltage. All drives to the right of the leader drives are follower drives. They receive the DC bus voltage extended from the leader drive through the shared-bus connection system:

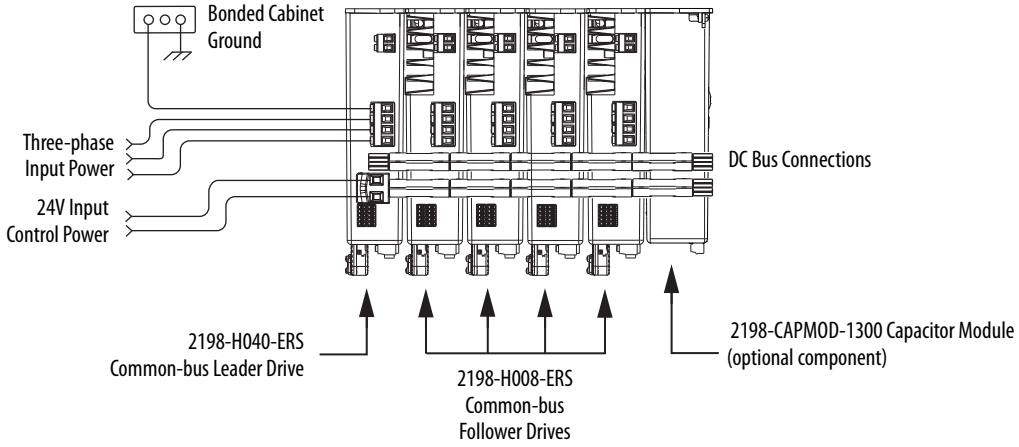
- For DC common-bus installations, the power rating of the leader drive must be greater than or equal to the power rating of the follower drives.
- The leader drive is configured in the project file as a Shared AC/DC drive.
- The follower drives are configured in the project file as Shared DC drives.
- Shared DC configurations support Bulletin 2198 capacitor modules.

Table 64 - Shared DC Panel Layout

Frame Size Combination	Leader Drive Cat. No.	Follower Drives, max (1)	Follower Cat. No.	Number of Capacitor Modules, max
1	2198-H003-ERS	4	2198-H003-ERS	0
	2198-H008-ERS	4	2198-H003-ERS	1
			2198-H008-ERS	1
2 and 1	2198-H015-ERS	6	2198-H003-ERS	1
			2198-H008-ERS	
2			2198-H015-ERS	
2 and 1	2198-H025-ERS	6	2198-H003-ERS	3
			2198-H008-ERS	
2			2198-H015-ERS	
			2198-H025-ERS	
2 and 1	2198-H040-ERS	6	2198-H003-ERS	3
			2198-H008-ERS	
2			2198-H015-ERS	
			2198-H025-ERS	
			2198-H040-ERS	
3 and 1	2198-H070-ERS	7	2198-H003-ERS	4
			2198-H008-ERS	
3 and 2			2198-H015-ERS	
			2198-H025-ERS	
			2198-H040-ERS	
3			2198-H070-ERS	

(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004.

Figure 76 - Typical DC Common Bus Configuration



IMPORTANT Total number of drives in Kinetix 5500 drive system must not exceed 8.

For an example shared DC installation with additional details, refer to Typical Shared DC Common-bus Installations on page 16.

Shared AC/DC Configurations

In a shared AC/DC configuration, the first (leftmost) drive receives AC input voltage. The shared-bus connection system extends the AC and DC bus to all downstream drives:

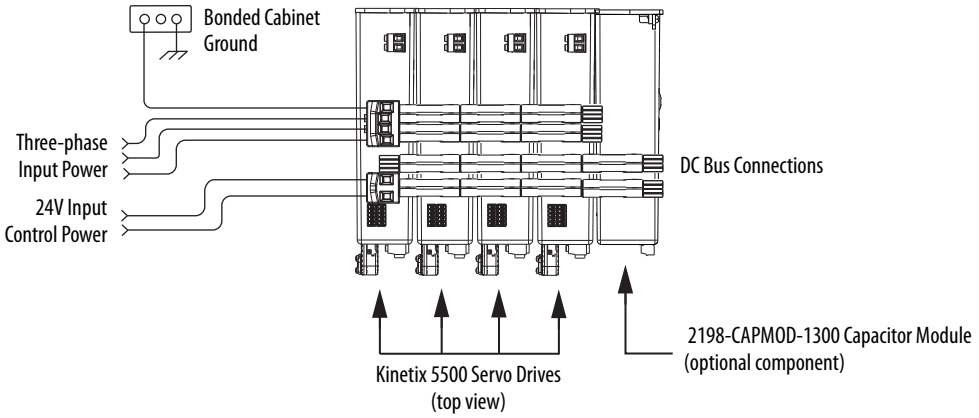
- All drives are configured in the project file as Shared AC/DC drives.
- Drives configured in the project file as Shared AC/DC must be of the same power rating (catalog number).
- Shared AC/DC configurations support Bulletin 2198 capacitor modules
- Total available converter power is derated by 30%.
- The maximum number of drives configured as Shared AC/DC is described in Table 65.

Table 65 - Shared AC/DC Panel Layout

Drive Cat. No.	Frame Size	Drives Configured as Shared AC/DC, max (1)	Number of Capacitor Modules, max
2198-H003-ERS	1	8	0
2198-H008-ERS			1
2198-H015-ERS	2	4	4
2198-H025-ERS			
2198-H040-ERS			
2198-H070-ERS	3	2	4

(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004.

Figure 77 - Typical Shared AC/DC Configuration


Bonded Cabinet Ground
Three-phase Input Power
24V Input Control Power
DC Bus Connections
2198-CAPMOD-1300 Capacitor Module (optional component)
Kinetix 5500 Servo Drives (top view)

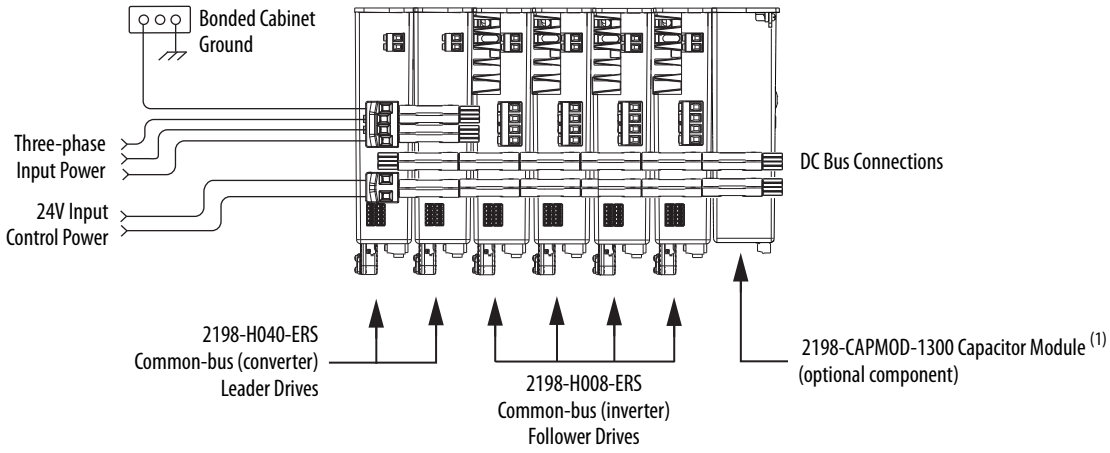
For an example shared AC/DC installation with additional details, refer to Typical Shared AC/DC Installations on page 15.

Shared AC/DC Hybrid Configurations

In shared AC/DC hybrid configurations, three-phase AC input power is supplied to two or more (leader) drives that act as converters. This parallel converter configuration increases the DC power supplied to the inverter (follower) drives:

- The leftmost drives in a hybrid configuration (configured as Shared AC/DC) act as parallel converter drives and must be of the same power rating (catalog number).
- Shared DC (inverter) drives mounted to the right of the shared AC/DC (converter) drives must have the same or lower power rating (catalog number) than the shared AC/DC drives.
- The total motoring load must not exceed the rated load for the drives sourcing the DC power. Each follower drive must be sized for the motor load connected to it.
- Total available converter power is derated by 30%.
- The maximum number of drives configured in the project file as Shared AC/DC is restricted according to Table 65 on page 164.
- The maximum number of drives configured in the project file as Shared DC is restricted according to Table 64 on page 163.
- Shared AC/DC hybrid configurations support Bulletin 2198 capacitor modules.

Figure 78 - Typical Shared AC/DC Hybrid Configuration


Bonded Cabinet Ground
Three-phase Input Power
24V Input Control Power
DC Bus Connections
2198-H040-ERS Common-bus (converter) Leader Drives
2198-H008-ERS Common-bus (inverter) Follower Drives
2198-CAPMOD-1300 Capacitor Module (1) (optional component)

(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004.

For an example shared AC/DC hybrid installation with additional details, refer to Typical Shared AC/DC Bus Hybrid Installations on page 17.

Power Sharing Sizing Examples

For best results, size motors based on load torque requirements using Motion Analyzer software. Select drives based on continuous or peak torque requirements. Based on the load profile, use Motion Analyzer software to estimate the net converter and inverter power and bus regulator capacity.

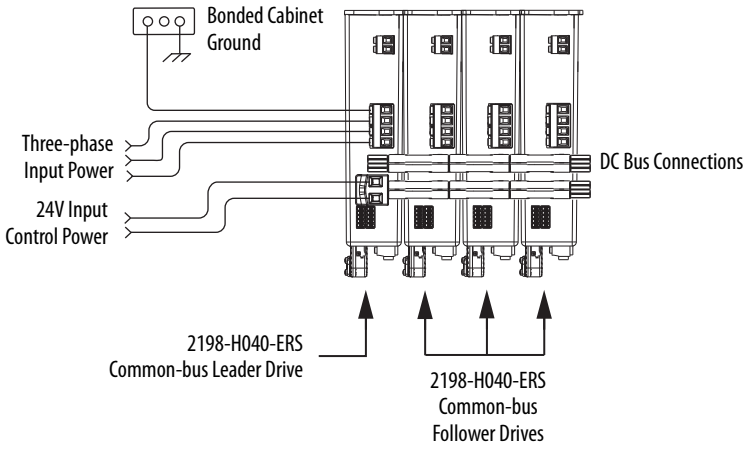
Table 66 - Converter and Bus Regulator Capacity

Configuration	Available Converter Capacity	Available Regenerative Capacity
Shared AC	Converter power rating of each drive	Internal shunt of each drive
Common bus	Converter power rating of leader drive	Sum of all internal shunts from each drive in bus-sharing group
Shared AC/DC	Sum of converter power ratings times 0.7 (70%)	
Shared AC/DC hybrid		

Shared DC Example

In this example four 2198-H040-ERS drives are used in a common-bus configuration.

Figure 79 - DC Common Bus Configuration



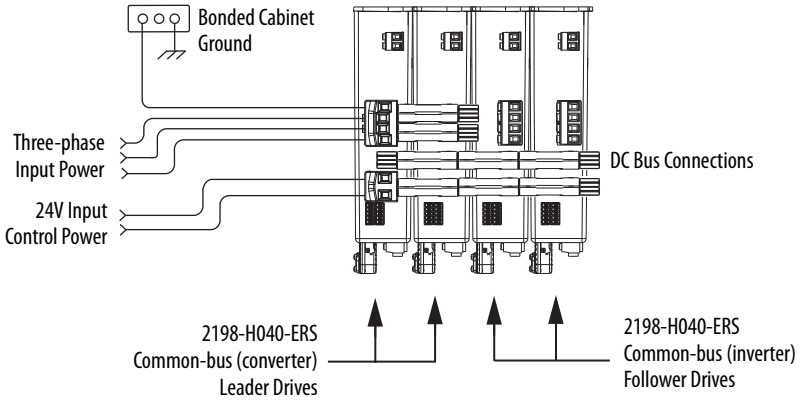
Each 2198-H040-ERS drive is rated at 8.4 kW continuous output power to bus. However, only the leader drive acts as the converter, so the available converter power to the system is 8.4 kW. In this example, total motoring load must not exceed 8.4 kW.

Shared AC/DC Hybrid Example

If the required motoring power exceeds the available converter power sourced by the shared DC configuration, then connect a second converter drive to make a shared AC/DC hybrid configuration. This increases the available converter power.

In this example, the same four 2198-H040-ERS drives are used, however, two are connected as parallel converter (leader) drives and the other two as common-bus (follower) drives. The total converter power is derated by 30%.

Figure 80 - Shared AC/DC Hybrid Configuration



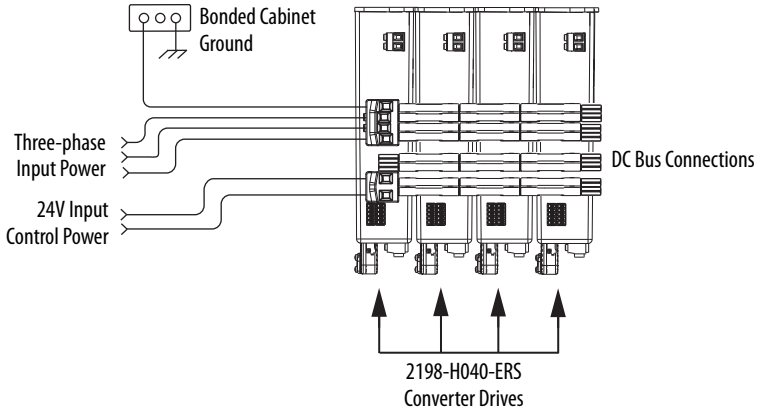
The available converter power to the system is (8.4 • 2) • 0.7 = 11.76 kW. In this example, total motoring load must not exceed 11.76 kW. The available converter power was increased by 30% over the same drives in shared DC configuration.

Shared AC/DC Example

If the required motoring power exceeds the available converter power sourced by two leader drives, then connect all four drives as parallel converter drives. This further increases the available converter power.

In this example, the same four 2198-H040-ERS drives are used, however, all four are connected as parallel converter (leader) drives. The total converter power is derated by 30%.

Figure 81 - Shared AC/DC Configuration



The available converter power to the system is (8.4 • 4) • 0.7 = 23.52 kW. In this example, total motoring load must not exceed 23.52 kW. The available converter power was increased by 65% over the same drives in shared DC configuration.

Control Power Current Calculations

Kinetix 5500 servo drives and the Bulletin 2198 capacitor module have different 24V DC power consumption. Factors to consider when calculating the combined current demand from your 24V DC power supply includes the following:

- Catalog number for each drive in the system
- Whether Bulletin VPL motors include the holding brake option
- Whether the system includes Bulletin 2198 capacitor modules (1 to 4 modules are possible)

Table 67 - Control Power Current Demand

Cat. No.	**24V Current (non-brake motor)** A_{DC}	**24V Current (2 A brake motor)** A_{DC}	**24V Inrush Current** (1) A
2198-H003-ERS	0.4	2.4	2.0
2198-H008-ERS			
2198-H015-ERS	0.8	2.8	3.0
2198-H025-ERS			
2198-H040-ERS			
2198-H070-ERS	1.3	3.3	
2198-CAPMOD-1300	0.3	N/A	2.0

(1) Inrush current duration is less than 30 ms.

Kinetix 5500 System Current Demand Example

In this example, the Kinetix 5500 drive system includes two 2198-H040-ERS drives, four 2198-H008-ERS drives, and one capacitor module.

Figure 82 - Shared AC/DC Hybrid Configuration

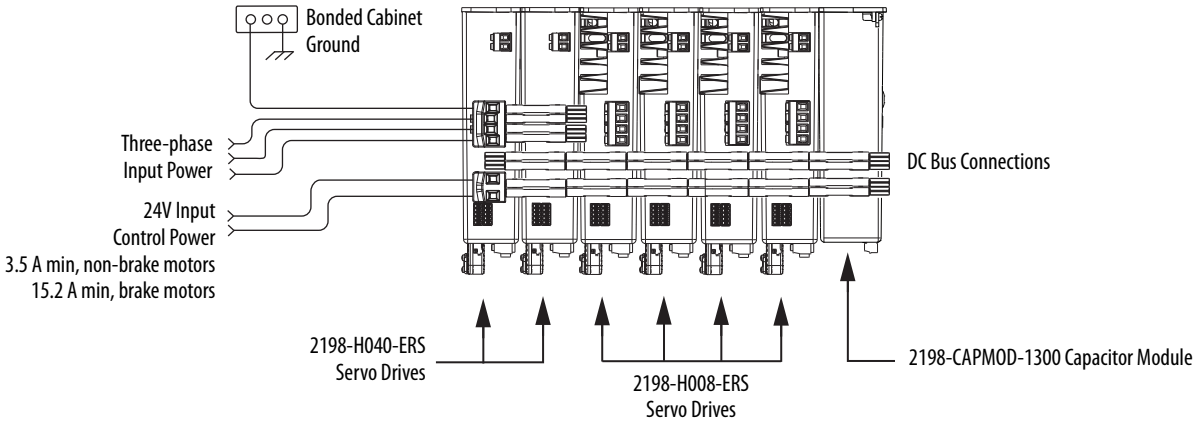


Table 68 - Kinetix 5500 System Current Demand Calculations

Kinetix 5500 Module Cat. No.	Qty	**24V Current (non-brake motors)** A_{DC}	**24V Current (2 A brake motors)** A_{DC}	**24V Inrush Current** (1) A
2198-H008-ERS	4	0.4 x 4 = 1.6	2.4 x 4 = 9.6	2 x 4 = 8
2198-H040-ERS	2	0.8 x 2 = 1.6	2.8 x 2 = 5.6	3 x 2 = 6
2198-CAPMOD-1300	1	0.3 x 1 = 0.3	N/A	2 x 1 = 2
Total current demand		3.5	15.2	16

(1) Inrush current duration is less than 30 ms.

Energy Calculations

The Kinetix 5500 servo drives have internal shunt resistors for dissipating excessive energy. In addition, Bulletin 2097 external shunt resistors and Bulletin 2198 capacitor modules are available to increase the shared DC bus capacitance.

Use this table to calculate the total energy absorbing potential (joules).

Table 69 - Energy Absorbing Potential

Kinetix 5500 Drive Cat. No.	Internal Shunt [2] J	External Shunt [1] J	Capacitor Module [2] kJ	Capacitor Module, max [3] kJ
2198-H003-ERS	427.09	TBD	N/A	N/A
2198-H008-ERS		TBD	554.4	554.4
2198-H015-ERS	549.01	TBD	676.32	676.32
2198-H025-ERS	575.223	TBD	702.53	957.162
2198-H040-ERS	601.434	TBD	728.74	983.373
2198-H070-ERS	1827.01	TBD	1954.3	2208.95

(1) External shunt values for Kinetix 5500 drives are being evaluated.
(2) Value assumes the use of one servo drive and one capacitor module.
(3) Value assumes the use of one servo drive and the maximum number of capacitor modules allowed.

Refer to Motion Analyzer software, version 7.0 or later, for custom shunt sizing.

Induction Motor Support

This appendix provides induction motor feature descriptions supported by Kinetix 5500 servo drives.

Topic	Page
Induction Motor Control Methods	171
Skip Frequency	174

Induction Motor Control Methods

The Kinetix 5500 servo drives support two open-loop frequency control methods. These are the choices:

- **Basic Volts/Hertz** - This method is used in single or multi-motor asynchronous motor applications.
- **Sensorless Vector with Slip Compensation** - This method is used for most constant torque applications. Provides excellent starting, acceleration, and running torque.

To configure your induction motor in the Logix Designer application, refer to Configure Induction Motor Axis Properties on page 101.

Open-loop frequency control is suitable in applications such as conveyors, pumps, and fans. These are the features:

- Start Boost, Run Boost, and Auto Boost
- Electronic motor thermal overload protection per Class 10 requirements
- Single skip frequency, in which the drive does not operate
- All three-phase induction motors suitable for variable speed drives (VFD) operation are supported

Table 70 - Induction Motor Specifications

Attribute	Value
Output frequency, max	400 Hz
Pole pairs, max	50
Motor cable length, max	50 m (164 ft)

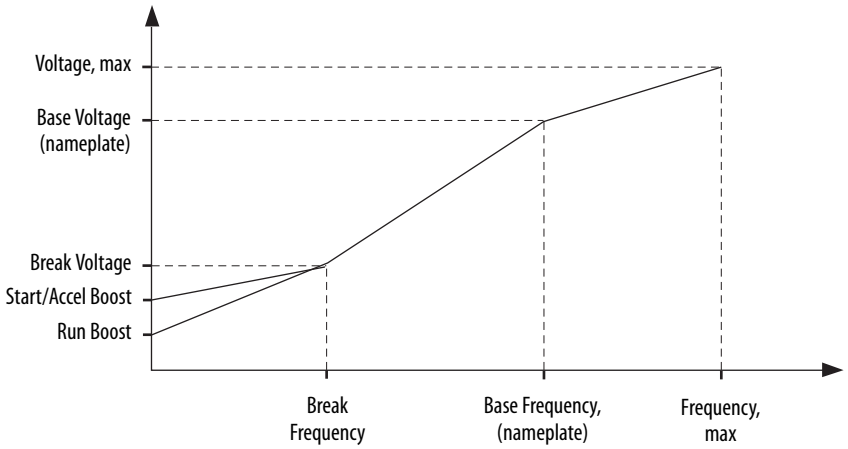
Basic Volts/Hertz

Volts/hertz operation creates a fixed relationship between output voltage and output frequency. Voltage is applied to the motor, based on the operating frequency command at a fixed volts/hertz ratio. The ratio is calculated from the motor nameplate data and entered into the Logix Designer application> Axis Properties>Frequency Control category.

The Basic Volts/Hertz method provides a variety of patterns. The default configuration is a straight line from zero to rated voltage and frequency. As seen in the diagram below, the volts/hertz ratio can be changed to provide increased torque performance when required by programming five distinct points on the curve:

- **Start Boost** - Used to create additional torque for breakaway from zero speed and acceleration of heavy loads at lower speeds.
- **Run Boost** - Used to create additional running torque at low speeds. The value is typically less than the required acceleration torque. The drive lowers the boost voltage to this level when running at low speeds (not accelerating). This reduces excess motor heating that could result if the higher start/accel boost level were used.
- **Break Voltage/Frequency** - Used to increase the slope of the lower portion of the Volts/hertz curve, providing additional torque.
- **Motor Nameplate Voltage/Frequency** - sets the upper portion of the curve to match the motor design. Marks the beginning of the constant power region.
- **Maximum Voltage/Frequency** - Slopes the portion of the curve used above base speed.

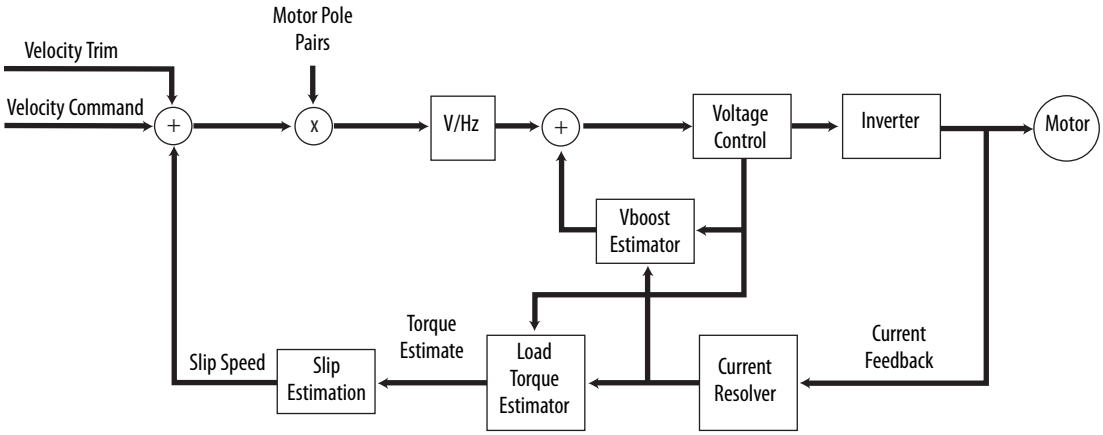
Figure 83 - Basic Volts/Hertz Method



Sensorless Vector

Sensorless Vector mode uses a volts/hertz core enhanced by a current resolver, slip estimator, and a voltage boost compensator based on the operating conditions of the motor.

Figure 84 - Sensorless Vector Method

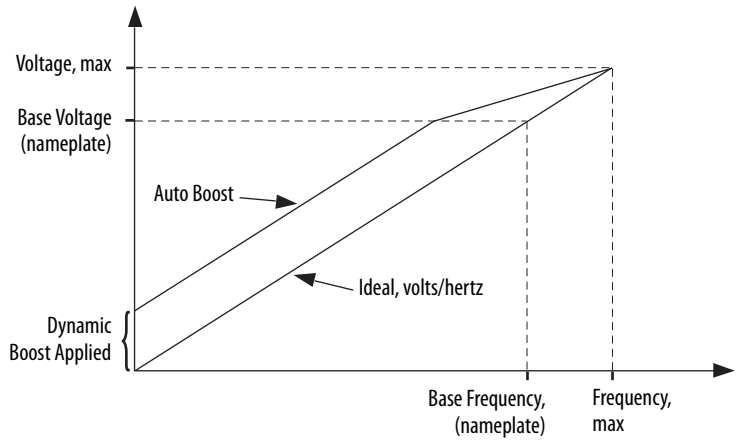


The algorithms operate on the knowledge of the relationship between the rated slip and torque of the motor. Drive uses applied voltages and measured currents to estimate operating slip frequency. You can enter values to identify the motor resistance value or you can run an autotune routine to identify the motor resistance value (see Tune the Axes on page 107). This is done so that the drive can accurately estimate the required boost voltage.

This method offers better torque production and speed regulation over a wider speed range than basic volts/hertz. However, it may not be appropriate when more than one motor is connected to the same drive.

The auto boost feature is applied internally to compensate voltage drop and improve starting torque.

Figure 85 - Approximate Load Curve



Skip Frequency

Some machines may have a resonant operating frequency (vibration speed) that is undesirable or could cause equipment damage. To guard against continuous operation at one or more resonant points, you can configure the SkipSpeed parameters in the Logix Designer application>Axis Properties>ParametersList category.

The value programmed into the SkipSpeed1 parameter, sets the center point for an entire skip band of frequencies. The width of the band (range of frequency around the center point) is determined by the SkipSpeedBand parameter. The range is split, half above and half below the SkipSpeed1 parameter.

If the commanded frequency is greater than or equal to the skip (center) frequency and less than or equal to the high value of the band (skip plus 1/2 band), the drive sets the output frequency to the high value of the band. See (A) in Figure 86.

If the commanded frequency is less than the skip (center) frequency and greater than or equal to the low value of the band (skip minus 1/2 band), the drive sets the output frequency to the low value of the band. See (B) in Figure 86.

Figure 86 - Skip Frequency

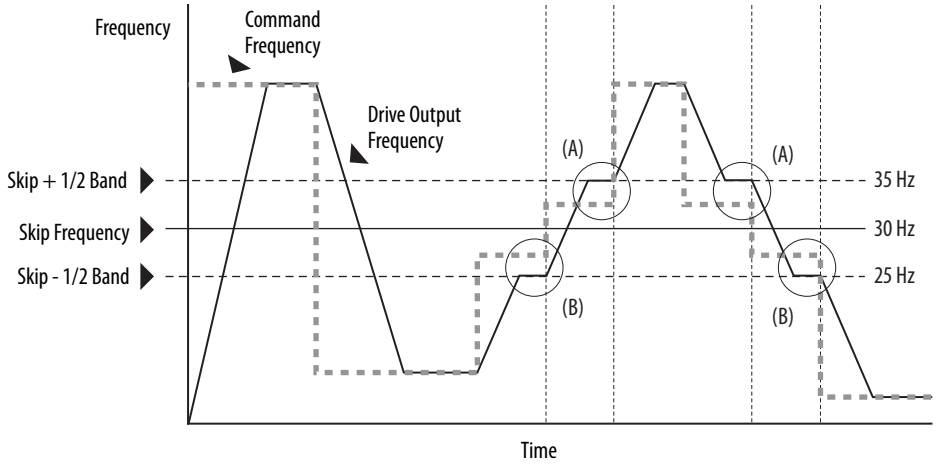
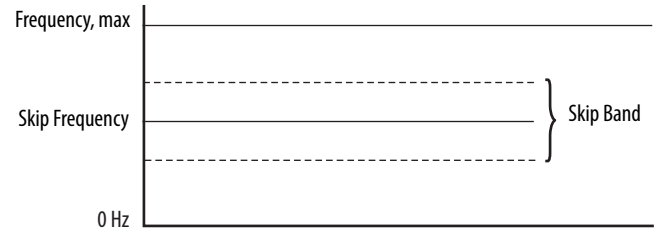
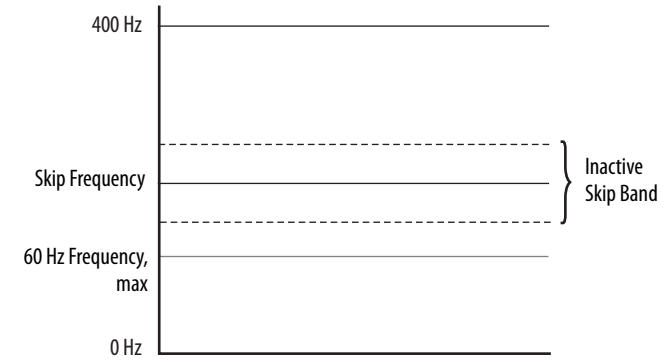


Table 71 - Skip Frequency Examples

Skip Band Description	Graphic Illustration
The skip frequency has hysteresis so the output does not toggle between high and low values. You can program three distinct bands. If none of the skip bands touch or overlap, each band has its own high/low limit.	
If the band is outside of the limits, the skip band is inactive.	

Acceleration and deceleration are not affected by the skip frequencies. Normal accel/decel proceeds through the band.

Notes:

EC Certifications

This appendix provides Kinetix 5500 servo drive certification information.

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EC Type - Examination Certificate

For product certifications currently available from Rockwell Automation, go to http://www.rockwellautomation.com/products/certification.

TÜVRheinland®

ZERTIFIKAT
CERTIFICATE

EC Type-Examination Certificate

Reg.-No.: 01/205/5255/12

Product tested	Safety Function "Safe Torque Off" (STO) within the adjustable Frequency AC Drives Kinetix 5500	**Certificate holder**	Rockwell Automation 6400 West Enterprise Drive Mequon, WI 53092 USA
Type designation	2198-H003-ERS, 2198-H008-ERS, 2198-H015-ERS, 2198-H025-ERS, 2198-H040-ERS, 2198-H070-ERS	**Manufacturer**	see certificate holder
Codes and standards forming the basis of testing	EN 61800-5-2:2007 EN ISO 13849-1:2008 + AC:2009 EN 62061:2005 + AC:2010 EN 61800-5-1:2007 (in extracts)		EN 61800-3:2004 EN 60204-1:2006 + A1:2009 + AC:2010 (in extracts) IEC 61508 Parts 1-7:2010
Intended application	The integrated safety function "Safe Torque Off" within the Frequency AC Drives Kinetix 5500 complies with the requirements of the relevant standards (Cat. 3/ PL d acc. to EN ISO 13849-1, SILCL 2 acc. to EN 62061/ EN 61800-5-2/ IEC 61508) and can be used in applications up to Cat. 3/ PL d acc. to EN ISO 13849-1, SIL 2 acc. to EN 62061/ IEC 61508.		
Specific requirements	The instructions of the associated Installation and Operating Manual shall be considered.		

It is confirmed, that the product under test complies with the requirements for machines defined in Annex I of the EC Directive 2006/42/EC.

This certificate is valid until 2017-10-01.

Functional Safety Type Approved TÜVRheinland FS

The test report-no.: 968/M 367.00/12 dated 2012-10-01 is an integral part of this certificate.

The holder of a valid licence certificate for the product tested is authorized to affix the test-mark shown opposite to products, which are identical with the product tested.

TÜVRheinland 0035 Notified Body

Berlin, 2012-10-01

Certification Body for Machinery, NB 0035

Dipl.-Ing. Eberhard Frejno

TÜV Rheinland Industrie Service GmbH, Abteilung SE, 12103 Berlin / Germany
Tel.: +49 30 7562-1370, E-Mail: kundi@de.tuv.com
Fax: +49 30 7562-1557

EC Declaration of Conformity

For all declarations of conformity (DoC) currently available from Rockwell Automation, go to http://www.rockwellautomation.com/products/certification/ce.

Rockwell Automation

EC Declaration of Conformity

The undersigned, representing the manufacturer	*and the authorized representative established within the Community*
Rockwell Automation, Inc. ***6400 W. Enterprise Drive*** ***Mequon, WI 53092*** ***U.S.A.***	***Rockwell Automation B.V.*** ***Rivium Promenade 160*** ***2909 LM Capelle aan den IJssel*** ***The Netherlands***
herewith declare that the Products	***Digital Servo Drives and Accessories Kinetix 5500***
Product identification (brand and catalogue number/part number):	***Allen-Bradley Bulletin 2198*** *(reference the attached list of catalogue numbers)*

Product Safety Function:	***Safe Torque-Off***

are in conformity with the essential requirements of the following EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:

2006/95/EC	*Low Voltage Directive*
2004/108/EC	*EMC Directive*
2006/42/EC	*Machinery Directive*

and that the standards and/or technical specifications referenced below have been applied:

EN 61800-5-1:2007	*Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy.*
EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
EN 61800-3:2004	*Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods*
EN 60204-1:2006/A1:2009	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
EN 60034-1:2010	*Rotating electrical machines – Part 1: Rating and performance*
EN 61508: Part 1-7:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems*
EN ISO 13849-1:2008	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

Year of CE Marking:	*2012*

Manufacturer:	*Authorized Representative in the Community:*
Signature	***Signature***
Name: Thomas Van Groll	*Name:* Iain Lindsay
Position: Director Engineering	*Position:* Regulatory Affairs (Europe)
Date: 31-Oct-2012	*Date:* 01-Nov-2012

Document Control Number: IMC-0040-B-EN 1 / 3

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Catalogue number	*Series* [3]	*Description*	*Directive* [4]		
			EMC	*LVD*	*MD*
Bulletin 2198 Servo Drives[1]					
2198-H003-ERS		*Kinetix 5500, Frame 1, 195-528Vrms, 0.6 kW, Inverter 1.0Amp, Safe Torque-Off*	*Yes*	*Yes*	*Yes*
2198-H008-ERS		*Kinetix 5500, Frame 1, 195-528Vrms, 1.6 kW, Inverter 2.5Amp, Safe Torque-Off*	*Yes*	*Yes*	*Yes*
2198-H015-ERS		*Kinetix 5500, Frame 2, 195-528Vrms, 3.2 kW, Inverter 5.0Amp, Safe Torque-Off*	*Yes*	*Yes*	*Yes*
2198-H025-ERS		*Kinetix 5500, Frame 2, 195-528Vrms, 5.2 kW, Inverter 8.0Amp, Safe Torque-Off*	*Yes*	*Yes*	*Yes*
2198-H040-ERS		*Kinetix 5500, Frame 2, 195-528Vrms, 8.4 kW, Inverter 13.0Amp, Safe Torque-Off*	*Yes*	*Yes*	*Yes*
2198-H070-ERS		*Kinetix 5500, Frame 3, 195-528Vrms, 14.9 kW, Inverter 23.0Amp, Safe Torque-Off*	*Yes*	*Yes*	*Yes*
AC Line Filters					
2198-DB08-F		*460 Volt 7.5 Amp Three-Phase AC Line Filter*	*Yes*	*Yes*	*N/R*
2198-DB20-F		*460 Volt 20 Amp Three-Phase AC Line Filter*	*Yes*	*Yes*	*N/R*
2198-DB42-F		*460 Volt 42 Amp Three-Phase AC Line Filter*	*Yes*	*Yes*	*N/R*
Shunts					
2097-R6		*75 Ohm, 150W, External Shunt Resistor*	*Yes*	*Yes*	*N/R*
2097-R7		*150 Ohm, 80 W, External Shunt Resistor*	*Yes*	*Yes*	*N/R*
Capacitor Module					
2198-CAPMOD-1300		*Kinetix5500 Capacitor Module*	*Yes*	*Yes*	*N/R*
Motor Compatibility[1,2]					
VPL-Axxxxx-yyyyyy		*230 Volt VP Low-inertia Servo Motor*	*Yes*	*Yes*	*N/R*
VPL-Bxxxxx-yyyyyy		*460 Volt VP Low-inertia Servo Motor*	*Yes*	*Yes*	*N/R*
Cable Compatibility[1]					
2090-CSWM1DF-YYAALL		*Motor power/feedback cable for use with VP family motors, YY = wire gauge, LL = length in meters*	*N/R*	*N/R*	*N/R*
2090-CSBM1DF-YYAALL		*Motor power/feedback with brake cable for use with VP family motors, YY = wire gauge, LL = length in meters*	*N/R*	*N/R*	*N/R*
Connector Kits and Miscellaneous Accessories[2]					
2198-H040-x-x		*Input wiring connectors and DC bus T connector for frame 1 and 2 servo drives*	*N/R*	*N/R*	*N/R*
2198-H070-x-x		*Input wiring connectors and DC bus T connector for frame 3 servo drive.*	*N/R*	*N/R*	*N/R*
1585J-M8CBJM-x		*Shielded Ethernet cable*	*N/R*	*N/R*	*N/R*
1606-XLxxx		*24V DC Power Supply*	*N/R*	*N/R*	*N/R*
2198-KITCON-DSL		*Replacement feedback connector kit for Kinetix 5500*	*N/R*	*N/R*	*N/R*
2198-KITCON-IOSP		*Replacement I/O connector kit (spring clamp) for IOD connector*	*N/R*	*N/R*	*N/R*
2198-KITCON-IOSC		*Replacement I/O connector kit (screw terminal) for IOD connector*	*N/R*	*N/R*	*N/R*

Rockwell Automation

Catalogue number	*Series* [3]	*Description*	*Directive* [4]		
			EMC	*LVD*	*MD*
Connector Kits and Miscellaneous Accessories[2]					
2198-KITCON-PWR40		*Replacement connector set, 40 Amp, for Kinetix 5500 Frame 1 & 2 drives*	*N/R*	*N/R*	*N/R*
2198-KITCON-PWR70		*Replacement connector set, 70 Amp, for Kinetix 5500 Frame 3 drives*	*N/R*	*N/R*	*N/R*

1) Only the following motor and cable families are compatible with the Kinetix 5500 servo drives.
2) The following letters are used in the compatibility matrix to indicate model number description fields that do not affect this DoC: x, y. These fields may be filled with any number(s) or letter(s).
3) If no series number is given, then all series are covered.
4) Legend as follows:
No = Product is not certified to this directive.
Yes = Product is certified to this directive.
N/R = this directive is not required for this product

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Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support, you can find technical manuals, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools. You can also visit our Knowledgebase at http://www.rockwellautomation.com/knowledgebase for FAQs, technical information, support chat and forums, software updates, and to sign up for product notification updates.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect^{SM} support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

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